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ILLUSTRATIONS

OF

THE EFFECTS

OF

DISEASE AND INJURY OF THE BONES,

WITH

DESCRIPTIVE AND EXPLANATORY STATEMENTS.

BY

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Fig. 1.



Fig. 2.



Fig. 5.



Fig. 3.



Fig. 6.

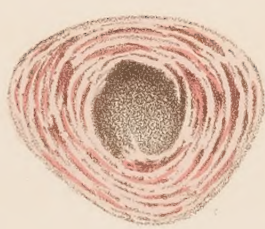


Fig. 7.

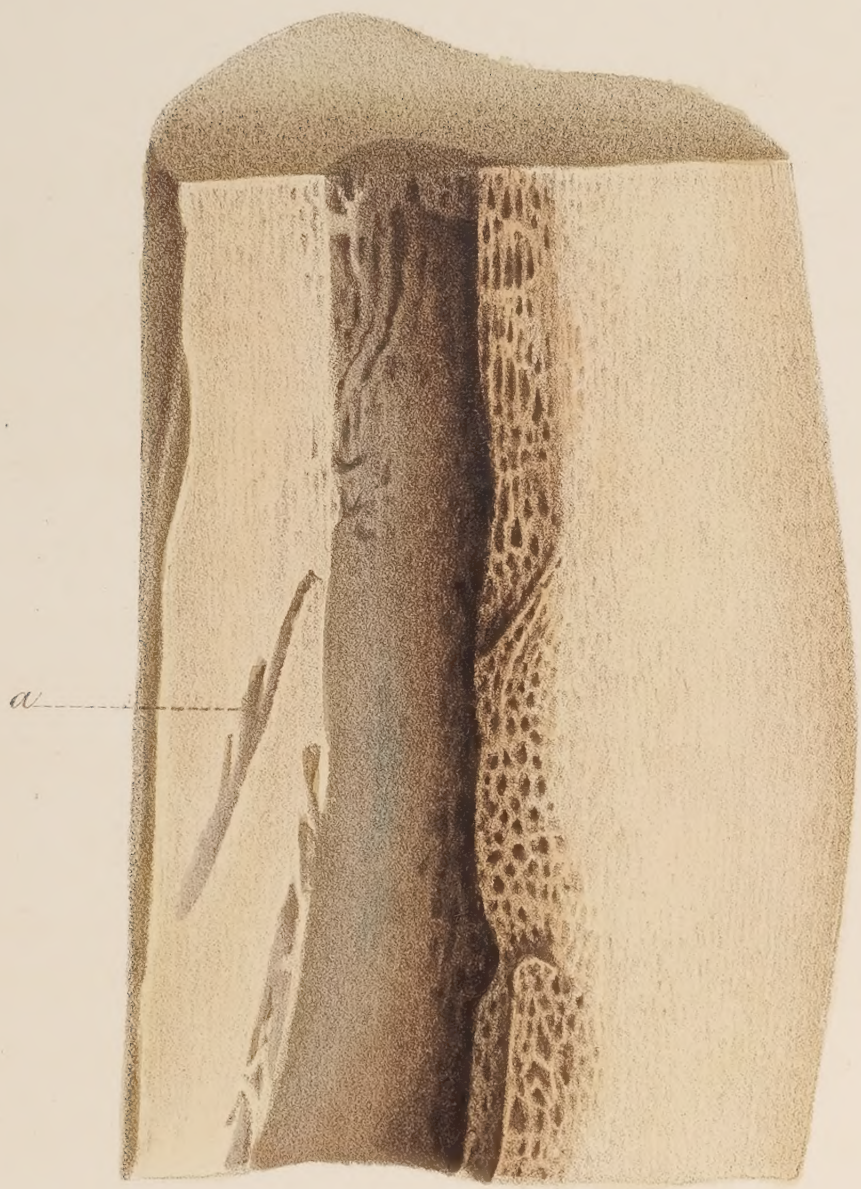


Fig. 4.



PLATE I.

DIFFUSE SUPPURATION IN BONE*—ENLARGEMENT OF BONE BY EXPANSION OF ITS TEXTURE†—
ENLARGEMENT OF BONE WITH INDURATION OF ITS TEXTURE†.

FIG. 1.—Diffuse suppuration through the cancellous and medullary texture of part of the shaft, of the neck and head of the femur.

The redness of the bone is the effect of inflammation in its tissue. The yellow spots dispersed through the cancellous texture are produced by deposits of pus in its cells.

Suppuration through the femur was in this instance the consequence of amputation of the thigh in its lower third, a month before death, on account of encephaloid disease, which originated in the condyles and lower part of the shaft of the femur. The history of the case forms part of the description of Plate 18.

FIG. 2.—Lower part of a humerus, enlarged by the expansion of its texture. There is no osseous deposit either upon the outside of the bone, or within it. The enlargement of the bone is caused by the separation of its lamellæ and by the widening of its cells. The bone is also softened and diminished in weight by the loss of part of its earthy constituents.

FIG. 3.—Transverse section of the bone represented in Fig. 2, exhibiting the separation of its lamellæ and the widening of its cells.

The altered form of the articular surface of this humerus is the effect of ulcerative disease, originating in the elbow joint. The articular ends of the radius and ulna were also enlarged by the expansion of their texture. From a boy aged ten years, who had long suffered from the disease in the elbow joint.

FIG. 4.—Upper part of a humerus, exhibiting inflammation of the bone with the enlargement of it by the expansion of its texture. The redness of the bone is the effect of inflammation in its tissue.

FIG. 5.—Corresponding portion of the opposite humerus from the same individual as that represented in Fig. 4. This bone, healthy in structure, and of its natural size, is represented in order that the enlargement of the inflamed bone may be made evident.

FIG. 6.—Transverse section of the bone represented in Fig. 4, showing the separation of its lamellæ and the widening of its cells.

For the representation of the three preceding specimens, I am indebted to Mr. Arnott, of University College Hospital, who allowed me the use of the original drawings of them, and furnished me with the following history of the case :—

“These bones were taken from the body of a boy eight years of age, upon whom excision of the elbow joint had been performed for scrofulous caries four months previously. The os humeri was sawn through immediately above the condyles. The wound never healed. Two months after the operation, symptoms of general dropsy showed themselves, and the lad died of effusion into the cavities of the chest and abdomen.

“The extremities of the three bones at the elbow had never united. They were bare and grated, and lay in a cavity bathed with purulent matter. On sawing through the humerus, about an inch and a half from its lower end, and finding the shaft enlarged, and its texture developed, I removed the whole, and afterwards the corresponding length of humerus of the opposite side, for the sake of comparison. When both humeri had been macerated and dried, the inflamed bone was found not to weigh so much by half as the healthy one.”

* Treatise, Part I. Chap. iv.

† Ibid. Chap. iii.

FIG. 7.—Section of a tibia, enlarged and indurated from chronic inflammation in its tissue. It is probable that the first change in this bone consisted in the expansion of its texture, and that subsequently, the separated lamellæ became thickened, hardened, and consolidated together; the hardening of its tissue being caused by osseous deposits upon the insides of the Haversian canals, narrowing some of them and obliterating others. Accordingly, a bone thus altered is less vascular, and less oily, than healthy bone.

There is no osseous deposit into the medullary tube, nor any change in the inner lamellæ of this bone; its medullary tube is therefore of the natural form and size, notwithstanding the great increase in the thickness of the surrounding walls.

The opposite tibia had undergone a perfectly symmetrical enlargement, with induration of its tissue.

a—Oblique canal in the walls of the bone which transmitted the principal artery of the medullary texture.

Enlargement of bone of the character here represented is an ordinary effect of long-enduring rheumatic inflammation in its tissue.

PLATE II.

CIRCUMSCRIBED SWELLINGS OF BONE FROM INFLAMMATION OF PERIOSTEUM*—HYPERTROPHY OF THE DIPLOE OF THE CRANIUM, CONSEQUENT ON RICKETS†—THICKENING OF THE WALLS OF BONE‡.

FIG. 1.—Tibia, upon the front surface of which there are (*a*, *b*) two circumscribed swellings of the character of syphilitic nodes.

Such swellings originate in inflammation of limited portions of the periosteum, followed by the expansion and thickening of the subjacent bone, with osseous deposits on its surface.

FIG. 2.—Section of a cranium, increased in its thickness by the hypertrophy of portions of its diploe, accompanied by the yielding of its outer table: hence there are prominences on the outside of the cranium, whilst the inside of it is unaltered.

It is not improbable that such an hypertrophy of the diploe of the cranium was the consequence of rickets occurring in early life; for in this disease, portions of the cranial bones are found not only softened, but also much increased in thickness: and by the subsequent reparative process, the bones regain their hardness, but they usually retain their thickness.

FIG. 3.—Section of a tibia, part of the walls of which are thickened from inflammation, the consequence of a blow upon the leg.

The changes in the bone have here consisted, first, in the separation of its lamellæ, and then in the thickening and consolidation of them. The inner lamellæ in separating have arched inwards, and in this way the medullary tube is narrowed.

a, *a*—The thickened periosteum covering the enlarged part of the bone. On one side of the bone, the thickened periosteum is in part detached from it.

This specimen exhibits the usual mode of obliteration of the medullary tube of a bone, which is by the separation and arching inwards of its inner lamellæ, not, as has been supposed, by ossification of the medullary membrane. Indeed, it is doubtful whether, under any circumstances of disease, the medullary membrane becomes ossified, or that osseous substance is ever produced from it. And this character of disease the medullary membrane evinces, notwithstanding its high endowments of organization, for it receives a large supply of blood, is acutely sensible, and when inflamed it readily suppurates and throws forth lymph.

* Treatise, Part IV. Chap. iii.

† Ibid. Part III. Chap. i.

‡ Ibid. Part I. Chap. iii.

*Osleitis
Deformans*

Fig. 1.



Fig. 2.



Fig. 3.



Plate 111.

Fig. 1.

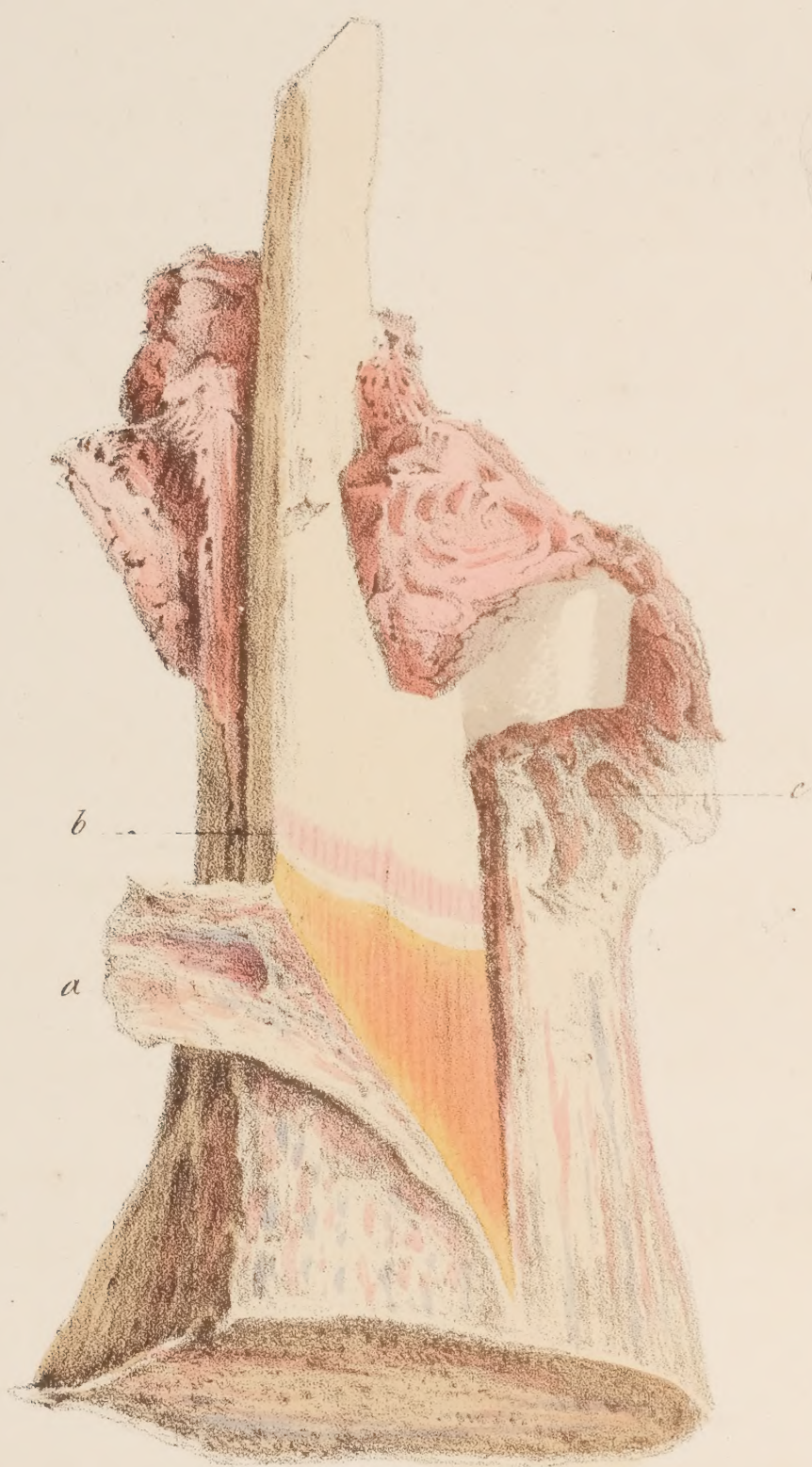


Fig. 2.

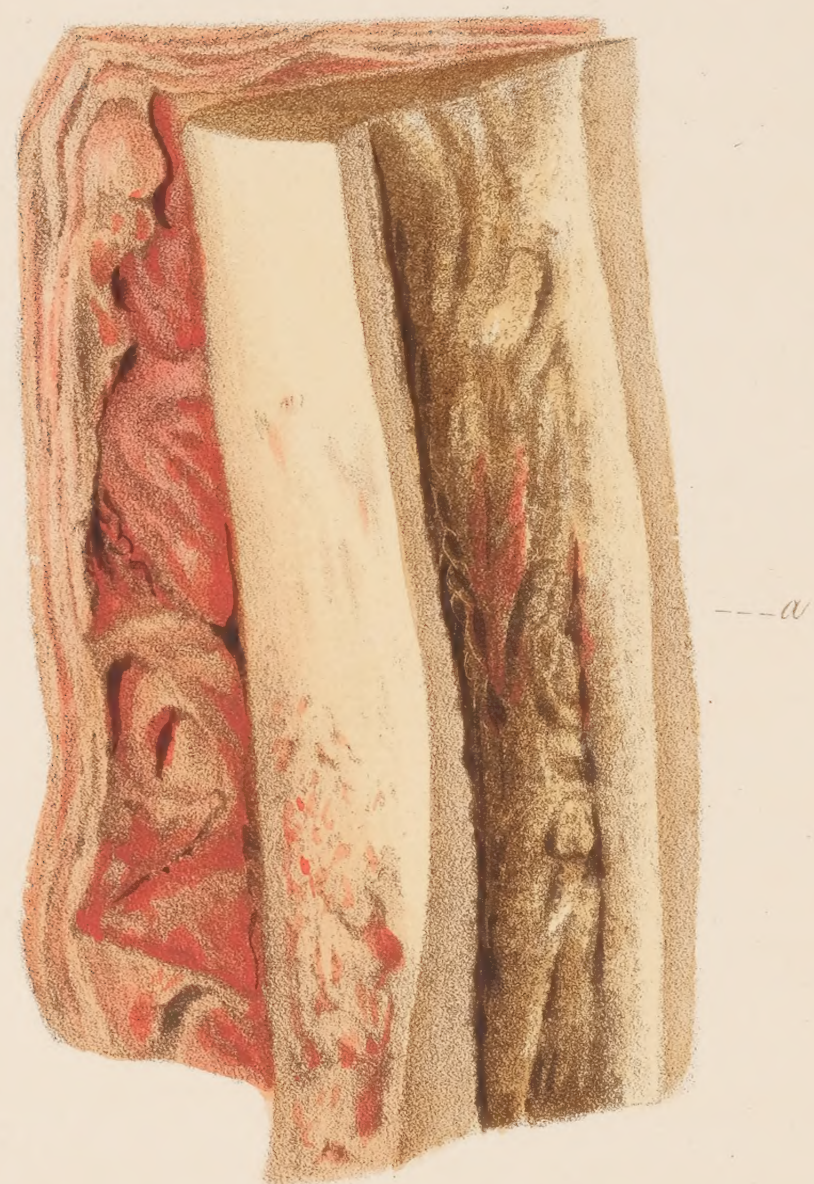


PLATE III.

NECROSIS AND EXFOLIATION, CONSEQUENT ON INJURY*—ABSCCESS IN THE MEDULLARY TEXTURE†.

FIG. 1.—Portion of a tibia which had recently suffered compound fracture.

The fractured end of the bone having perished, inflammation has ensued in the adjacent periosteum and living bone, and the formation of the groove of separation between the living and dead bone has commenced.

a—The inflamed periosteum thick, soft, and excessively vascular; it was very easily separable from the bone.

The redness of the surface of the bone, from which the periosteum is detached, is owing to inflammation of its tissue.

b—The groove of separation just commencing between the dead and living bone.

c—Blood effused into the cellular tissue around the bone and into its medullary texture.

In this specimen are exhibited the several changes constituting the first stage in the process of exfoliation. At a more advanced stage of the process, osseous deposits take place from the inflamed periosteum upon the living bone, along the border of the groove separating it from the dead bone. The groove, here just commencing, is but faintly indicated; it is formed, not in the dead bone, but in the living bone immediately adjacent to it.

FIG. 2.—Section of a tibia exhibiting changes consequent on the formation of a small abscess within its medullary texture.

The integuments with the periosteum opposite to the seat of the abscess are detached from the bone. The periosteum is acutely inflamed, its texture is soft, pulpy, and excessively vascular, its internal surface is flocculent, and it was very readily separable from the bone.

a—Seat of the abscess.

This specimen was prepared by Dr. Macartney, who alludes to it in a letter published by Mr. Crowther, in his *Observations on White Swelling*. “In one instance,” observes Dr. Macartney, “I found the periosteum vascular and pulpy, when the only affection was a small abscess of the medulla, the bone still retaining its connexion with the neighbouring parts as it readily received injection.”

Our knowledge of the progress of morbid changes in bone instructs us, that, in this instance, the abscess within the bone was the primary disease, and that the inflammation of the periosteum was consequent upon it. It might be expected that acute suppuration, even to the smallest extent within a bone, would be followed by inflammation in the corresponding portion of its periosteum, occasioning in it such alterations of structure as are here represented.

It may be of use to state what would almost certainly have been the further changes in the bone here represented, consequent on the small abscess in its medullary texture, if the life of the patient had been prolonged. Ulceration ensuing in the walls of the bone at the seat of the abscess, a narrow channel would thus be formed in them, giving passage to the matter from the interior to the outside of the bone. Whilst this channel was forming in the walls of the bone, a circumscribed soft swelling would arise in the soft parts covering it. Matter being discharged from this swelling, at the bottom of it the orifice of the narrow channel in the bone would be discovered, extending through its walls to the medullary texture. It might be expected, moreover, that immediately around the abscess in the bone, small pieces of its cancellous texture would perish, and that these, when exfoliated, would require to be extracted through the walls of the bone.

* Treatise, Part I. Chap. vii.

† Ibid. Chap. iv.

PLATE IV.

VARIETIES OF ULCERATION IN BONE *—PECULIAR DISEASE IN BONE CORRESPONDING WITH THE
ACCOUNT OF CRIES BY ANCIENT AUTHORS †.

FIG. 1.—Portion of a cranium in which there are two syphilitic ulcers. Ulceration having commenced at many distinct points in the outer table of the skull, minute round holes are formed in the bone, giving to it a worm-eaten appearance. Around the ulcers there is a shallow channel in the bone, resembling the groove of separation between dead and living bone. Accordingly, it is probable that the ulcerated portions of bone had perished, and were in progress of exfoliation.

The foregoing is an example of syphilitic ulcer in bone of such peculiar characters, that no other disease is likely to be mistaken for it. But there are varieties of syphilitic ulceration in bone corresponding with the various syphilitic eruptions and ulcers in skin and mucous membrane. The several forms of syphilitic ulcer in bone are described by Mr. Paget in the Catalogue of the Pathological Specimens contained in the Museum of the Royal College of Surgeons ‡.

FIG. 2.—Portion of a fibula deeply and extensively ulcerated upon its outer surface. The characters of the ulcerated bone are peculiar, and they remarkably agree with the following description by Mr. Hunter of a variety of ulcer in soft parts :—"The ulcerated sore is made up of little cavities or hollows, and the edge of the skin is scalloped or notched, is thin, turned a little out, and overhangs more or less the sore §."

This specimen represents a form of malignant ulcer in bone. It was obtained from a man fifty years of age, in whom, thirty years previously, the fall of a heavy piece of timber upon his leg was followed by repeated abscesses and ulcerations in the soft parts. Ulceration extending into the bones had destroyed part of the shaft of the tibia through its entire thickness, and it was extending into the fibula when the limb was amputated.

FIG. 3.—Portion of a tibia, in the front surface of which there is an ulcer, the consequence of simple inflammation. The surface of the ulcer is rough and porous. Around the ulcer there are deep and closely-arranged furrows in the bone : these are its vascular canals enlarged from inflammation.

FIG. 4.—Lower part of a tibia which has undergone a peculiar change of structure in its shaft, just above the articular extremity. The skin and subjacent soft tissues are removed from part of the bone. Upon the remaining part of it they are left to show the condition of the skin, which is indurated and tuberculated. The altered structure of the bone extends through its shaft, affecting both the solid walls and cancellous texture. The surface of the diseased bone is yellow, its texture is soft and crumbling ; and during life there was a foetid secretion constantly discharged from it.

a—The indurated and tuberculated skin over the diseased bone.

b, b—Healthy surface of the bone beyond the disease.

c—A fracture extending through the diseased bone, which may have occurred in the process of injecting the limb.

The disease in the tibia which is here represented, affecting both its compact and cancellous tissue, apparently consists in a fatty degeneration of the bone. It agrees with the account of caries by some of the ancient writers, who stated it to consist in a mouldering or crumbling of the osseous tissue.

* Treatise, Part I. Chap. vi.

† Vol. II. page 113.

‡ Ibid. Chap. v.

§ Treatise on the Blood, &c.

Fig. 1.



Fig. 2.



Fig. 4.



Fig. 3.



Plate V.

Fig. 2

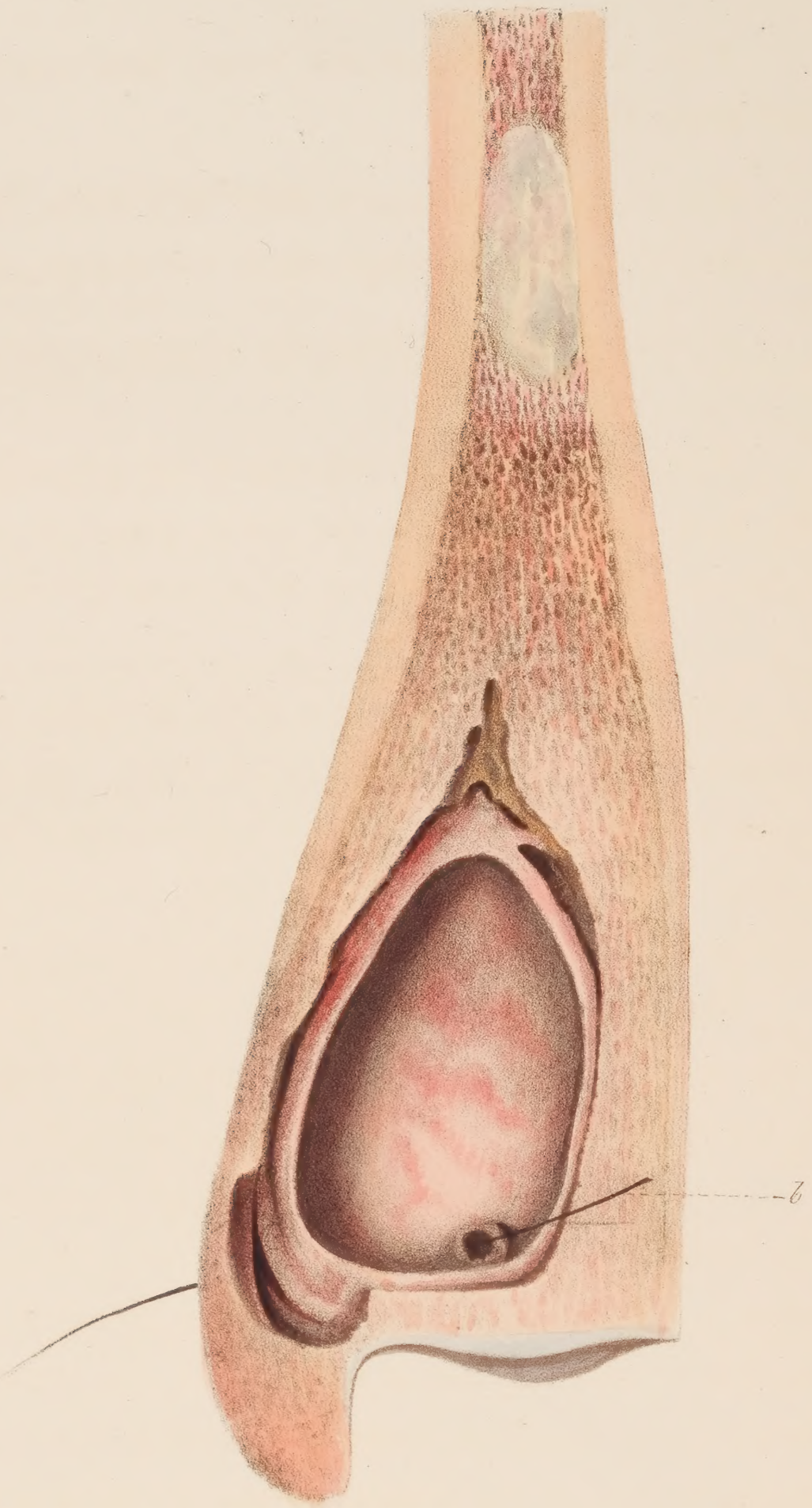


Fig. 4.



PLATE V.

CIRCUMSCRIBED ABSCESS IN BONE.*

FIG. 1.—Lower part of a femur, from a young person, in which an abscess has formed in the cancellous texture, just above the condyles.

The cavity in the bone is lined by a thick, very vascular membrane. Between the condyles, there is an ulcerated passage in the bone, through which the abscess communicated with the knee joint.

a—The membrane lining the abscess in part separated from the bone, and turned downwards.

From the history of the case it was inferred that the abscess in the bone preceded the occurrence of disease in the knee joint, and that the communication of the abscess with the joint was directly followed by destructive inflammation of its structures, on account of which the limb was amputated.

FIG. 2.—Lower part of a tibia, in which there is an abscess of considerable size. The membrane lining the abscess is in part separated from the bone. At the lower part of the abscess, there is a small circular hole in the lining membrane, from which a narrow canal is continued through the walls of the bone to its outer surface. A bristle (*b*) is introduced into this canal, through which the fluid secreted into the abscess must have escaped from the interior of the bone into the soft parts around it.

This disease had been twelve years in progress. Through the larger portion of this time it had occasioned but little pain. There were, however, periods of severe suffering, which were probably the times when obstacles occurred to the free escape of the purulent fluid from the interior of the bone into the soft parts around it.

Two circumstances in the history of circumscribed abscess in bone are illustrated by these examples of it. One is the tendency of the abscess within the articular end of a bone to form a communication with the adjacent joint; the other is the alternation of complete remissions of pain with paroxysms of suffering often observed in such cases. The periods of suffering are, it is probable, the periods when the abscess is distended by its contents. When, as in the instance just described, a channel forms in the osseous wall of the abscess, permitting the escape of the matter from its cavity, so long as the channel is free, the abscess will not become distended, and the disease under these circumstances will be but little painful. But when, from obstruction arising to the escape of the matter from the abscess, this becomes distended, then, certainly, it might be expected that severe suffering would ensue.

In such instances of abscess in bone as the foregoing, no other changes usually occur in the surrounding bone than either the induration of its texture, or the absorption of it accompanying the enlargement of the abscess. And when the abscess enlarges beyond the limits of the bone, in most instances this is accompanied by the extension of its walls into a thin osseous cyst. Occasionally, however, such an enlargement of the abscess is accompanied by hypertrophy of the walls of the bone, of which a remarkable example will be found in Plate VI.

* Treatise, Part I. Chap. iv.

PLATE VI.

CIRCUMSCRIBED ABSCESS IN BONE, ACCOMPANIED BY HYPERTROPHY OF ITS OSSEOUS WALLS.*

The disease is situated in the head and upper part of the shaft of the tibia.

FIG. 1.—Outer surface of the osseous walls of the abscess covered by periosteum.

FIG. 2.—Interior of the abscess, with the divided surface of its thick osseous walls.

In each of the figures, a plug of wood is represented filling a circular aperture in the lower part of the walls of the abscess.

This remarkable example of abscess in bone is contained in the Museum of the Royal College of Surgeons in Edinburgh. For the representations of it, and for the following history of the case, I am indebted to the late Professor Russell.

“Charles Anderson, aged 31, in the summer of 1814, when on a voyage to the Baltic, fell on deck with his leg under him; this was followed by great swelling below the knee, and inability to use the limb. The swelling subsided, and the power of using the limb so far returned that he was able to walk upon crutches, when he had a second fall, which completely disabled him, and was followed by a return of the swelling. In the winter, 1815—1816, he became a patient in the Edinburgh Infirmary, when amputation was proposed; but to this he would not consent. In the spring, 1817, the swelling was punctured, and a little bloody pus discharged. The opening soon healed. In the winter, 1817—1818, he had a severe fever, during which an opening formed where the incision had been made. The opening remained, discharging a bloody serum, sometimes mixed with blood and pus, and portions of bone. The discharge gradually increased to eight, twelve, even to sixteen ounces in twenty-four hours. When he began to walk, he was obliged to use a plug of wood and tow. He removed the plug once or twice a day to discharge the fluid from the cavity in the bone, which he then washed out. His health during the last twelve years has been good, until within six or eight months of the present time, when hectic symptoms appeared with increased discharge. The limb was amputated in February, 1831.”

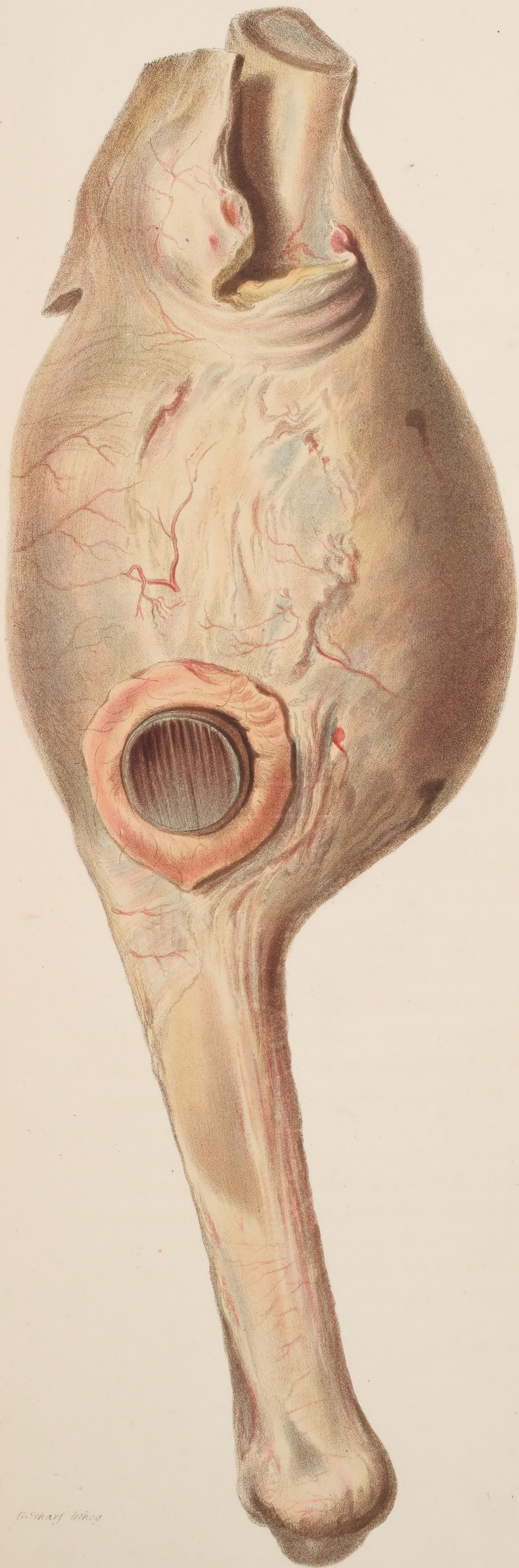
Notes of the Examination of the Limb by Dr. Knox.

“The integuments covering the tumor are every where sound. On the anterior and inner aspect of the limb, a circular opening, rather more than an inch in diameter, led into the interior of the tumor. The integuments were continued into the opening for a short way, passing insensibly into a soft mucous-looking membrane which lined the whole interior of the osseous case.

“A section of the tibia in its long axis showed its upper part dilated into an enormous cavity, capacious enough to contain sixteen ounces and a half of fluid, lined throughout by the membrane already described, and communicating externally by means of the aperture which the patient was in the habit of plugging up. The lower portion of the tibia was quite sound. The medullary cavity of this portion did not communicate with the diseased cavity above. The walls of this cavity, consisting of bone of considerable thickness, did not present any remarkable or diseased appearance. The muscles and other soft parts around the tumor were perfectly healthy.”

* Treatise, Part I. Chap. iv.

Fig. 1.



G. Scharf lithog.

Fig. 2.



Printed by C. Hallman del.

Fig. 1

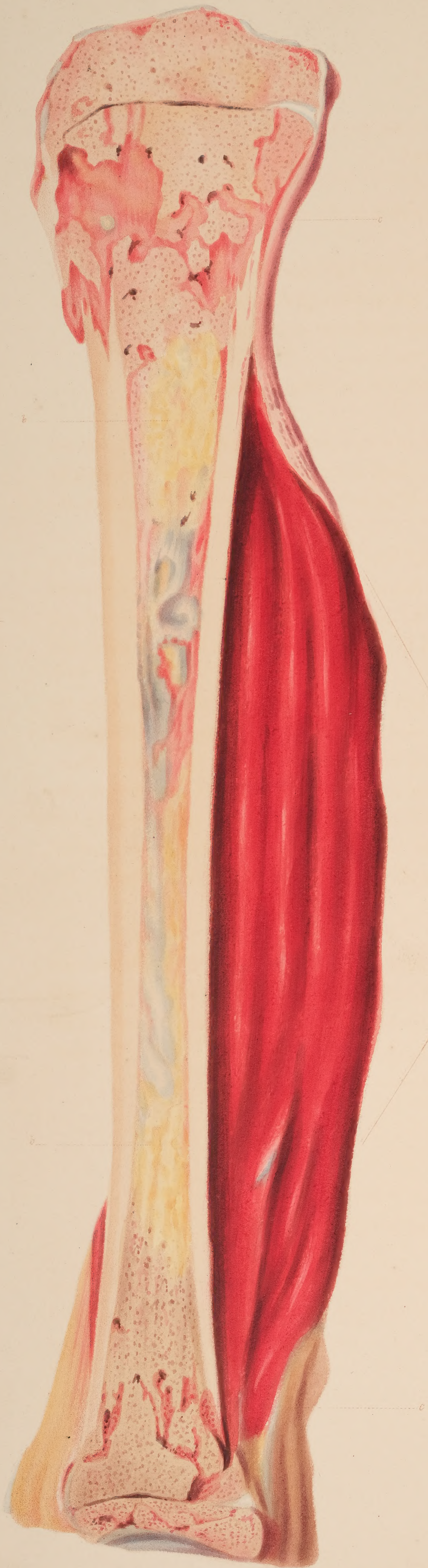


Fig. 2



PLATE VII

INFLAMMATION IN THE MEDULLARY MEMBRANE *—NECROSIS OF THE WALLS OF A BONE NOT IMPLICATING ITS MEDULLARY TEXTURE†.

FIG. 1.—Section of a tibia, exhibiting the effects of acute inflammation in the medullary membrane through the entire shaft of the bone.

a—The periosteum, which was separated from the shaft of the bone, and had undergone the usual changes from acute inflammation in its tissue. The membrane is thickened, soft, and excessively vascular. Its internal surface presents a velvet-like aspect, somewhat resembling in its characters those of inflamed conjunctiva.

b, b—Deposits of purulent fluid throughout the medullary tube of the bone.

c—Grooves of separation commencing between the shaft of the bone and its articular ends.

It might be expected that suppuration through the medullary tube of a bone with inflammation of its periosteum would be followed by the death of its shaft. That, in this instance, the shaft of the bone had perished, was shown by the entire detachment of the periosteum from it, also by the grooves of separation already commenced between the shaft and articular ends.

This disease occurred in a youth eighteen years of age ; and it had been only seven weeks in progress when the limb was amputated. The history of the symptoms indicated that the disease commenced in the medullary membrane of the tibia, and thence extended through the walls of the bone to its periosteum, also through the articular ends of the bone into the adjacent joints. Purulent fluid was consequently found in the knee and in the ankle joints, and their cartilages were almost wholly destroyed.

When it is considered that the several inflammatory changes here described within the tibia, and upon the outside of it, also in the knee and ankle joints, had occurred in seven weeks from the commencement of inflammation in the medullary membrane of the bone, it will be evident that this is a most formidable disease by its local effects : and it is not less so by the constitutional derangement to which it gives rise : for, in this case, the vital powers were reduced so low by the severity of the suffering which had accompanied the disease in the bone, and in the adjacent joints, that it was doubtful whether the removal of the limb could be sustained with a prospect of recovery. Accordingly, I amputated the limb without removing the patient from the water-bed upon which he was lying. His recovery was slow, but complete.

FIG. 2.—Section of a tibia, in which there is necrosis of the walls, but not extending to the medullary and cancellous texture. The perished walls of the bone, distinguished by their yellow colour, are almost completely separated. Between the dead bone and the medullary texture, is a space filled by soft granulations. Around the old walls of the bone, new walls are in progress of formation from the internal surface of the periosteum. The inner surface of the new bone is lined by soft granulations filling the space between it and the dead bone.

a, a—The perished walls of the bone.

b—The medullary and cancellous texture.

c—The new walls of the bone in progress of formation.

d—Granulations lining the new bone, and filling the space between it and the dead bone.

e—Space between the perished walls of the bone and the medullary texture filled by granulations.

The circumstance of the necrosis of the walls of the bone, in this instance not extending to the medullary and cancellous texture, may be attributed to the mode in which the death of the bone occurred. Nitric acid was applied to a sloughing ulcer in the front part of the leg. The action of the acid extending through the soft parts to the periosteum, the walls of the bone in consequence perished.

* Treatise, Part I. Chap. iv.

† Ibid. Chap. vii.

PLATE VIII.

REPARATIVE PROCESSES CONSEQUENT ON NECROSIS IN ANIMALS*.

FIG. 1.—Tibia of a dog, in which necrosis of the entire shaft of the bone ensued from the mechanical destruction of its medullary tissue. Newly-formed bone, invested by the original periosteum, almost completely surrounds and encloses the old and dead bone.

a—Fistulous passage extending through the walls of the new bone to the dead bone.

b—The perforation which was made in the walls of the old bone for the purpose of destroying its medullary tissue.

FIG. 2.—Section of the tibia of a dog in which necrosis of the entire shaft of the bone ensued from the mechanical destruction of its medullary tissue. The new bone, invested by the periosteum of the old bone, is in great part formed. The old bone is separated from its articular extremities. The inner surface of the new bone is lined by a very vascular membrane which is in contact with the dead bone.

a, a, a, a—The periosteum which originally belonged to the old bone, now investing the new bone.

b—The dead bone exposed where there is no new bone covering it.

A fistulous passage extends through the walls of the new bone at its lower part to the cavity enclosing the dead bone.

FIG. 3.—Enlarged view of the tibia of a dog, exhibiting the process of reparation ensuing after the removal of a portion of the walls of a bone without injury to its medullary tissue.

a—Space where the walls of the bone were removed. This space is almost filled by new osseous substance produced from the exposed medullary tissue.

b—Outer lamellæ of the bone which have perished from the injury they suffered in the experiment of removing part of its walls.

c—Red line in the living bone adjacent to the perished outer lamellæ. This increase in the vascularity of the living bone is the first step in the process of separation of the dead bone.

d—Granulations from the living bone extending some way over the dead bone.

FIG. 4.—Section of the tibia of a dog in which necrosis of the entire shaft of the bone ensued from the mechanical destruction of its medullary tissue. Here the reparative process is exhibited in an earlier stage than in Figures 1 and 2. The shaft of the old bone is separated from its articular extremities, but the formation of the new bone is very little advanced.

a a—The periosteum which belonged to the old bone, now investing the new bone.

b, b, b—The new bone.

c c—The vascular membrane lining the new bone.

d—The old bone separated from its articular extremities.

FIGURES 1, 2, 4—Are examples of the reproduction of the shaft of a bone apparently by the periosteum alone, when the death of the original shaft had ensued from the destruction of its medullary tissue.

FIG. 3—Is an example of the reparation of the walls of a bone by its medullary tissue, independently of the periosteum. In the following instance, this mode of repairing the injury done to the walls of a bone was observed in man. In a forearm, torn by machinery, four inches of one side of the ulna were detached by a longitudinal fracture. Granulations quickly arose from the exposed medullary tissue, and it appeared to be by the ossification of these granulations that the lost portion of the walls of bone was replaced.

* Treatise, Part I. Chap. vii.

Fig. 1.

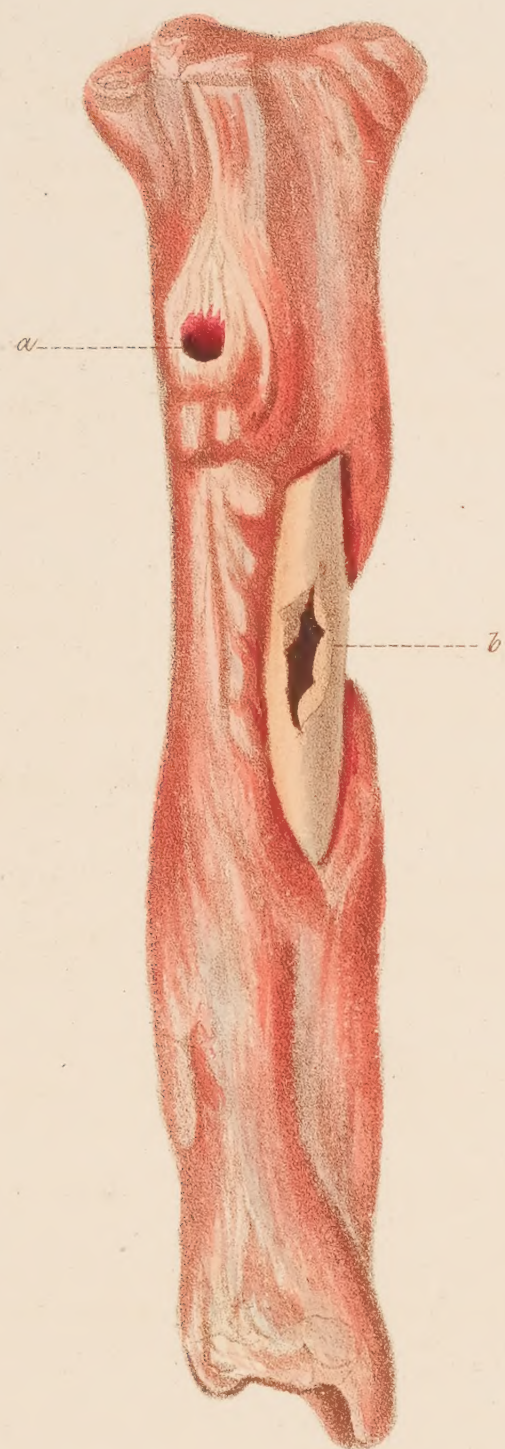


Fig. 2.

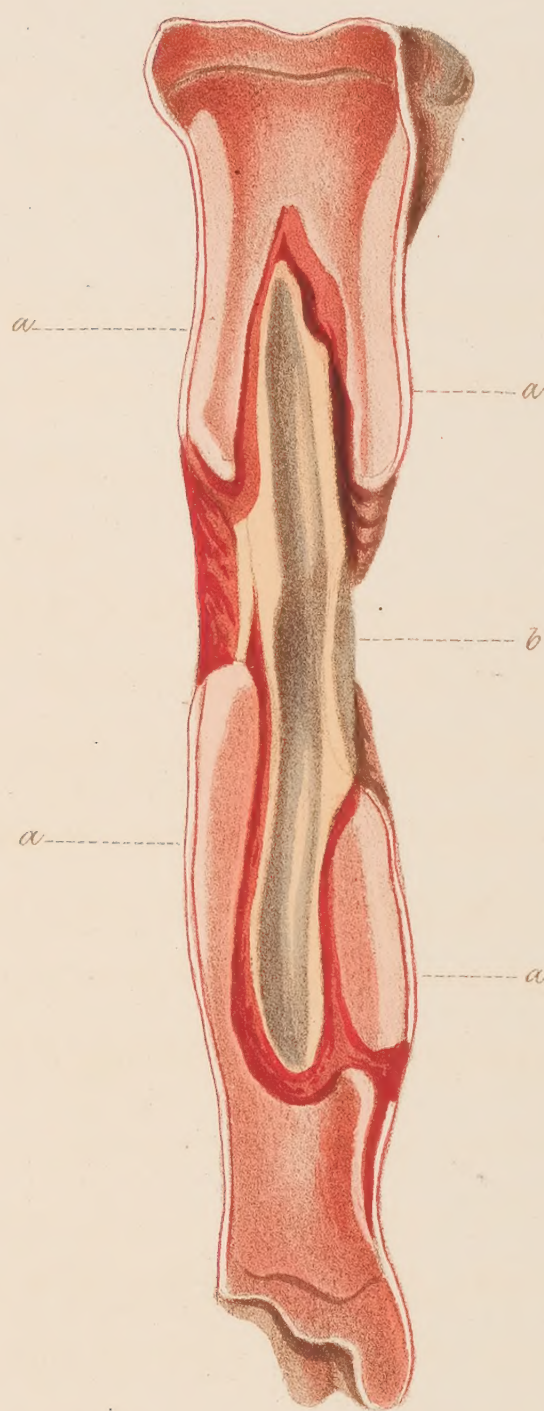


Fig. 3.

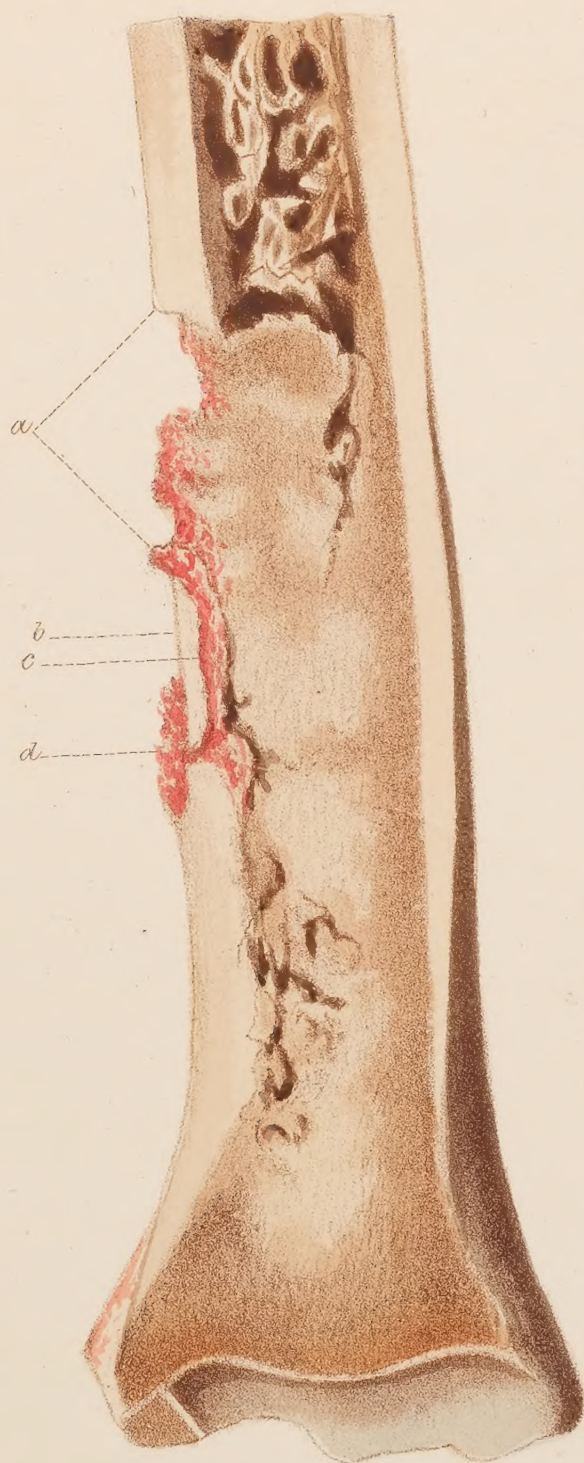


Fig. 4.

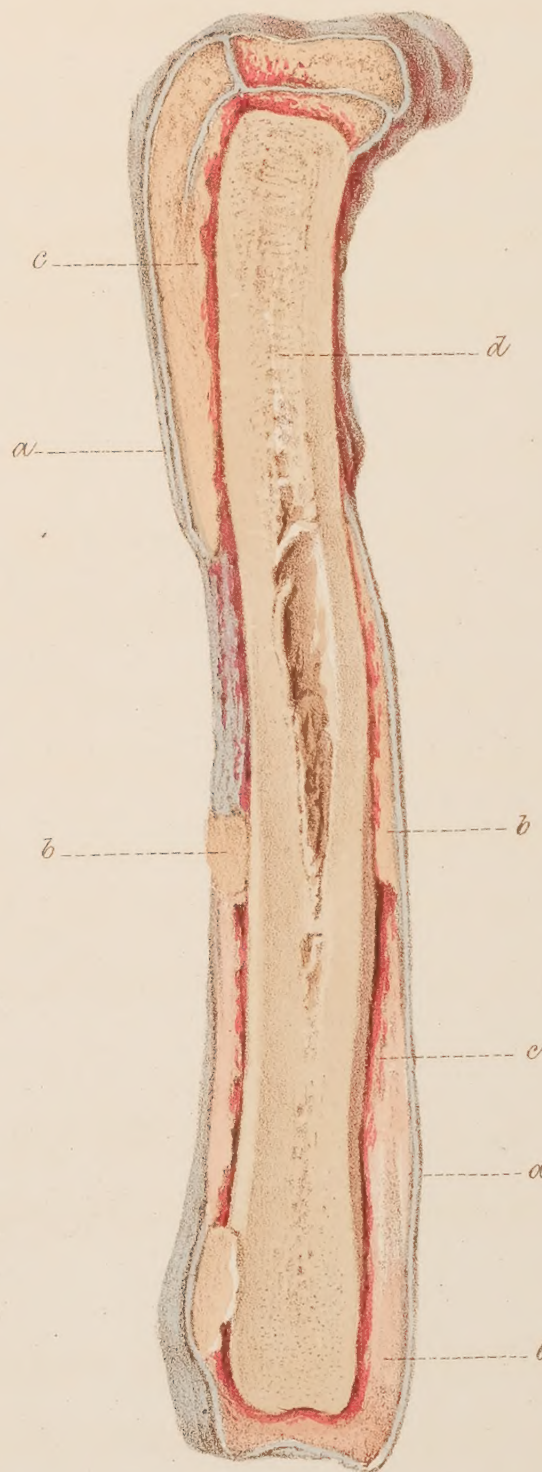


Fig. 1.



Fig. 2.



Fig. 3.

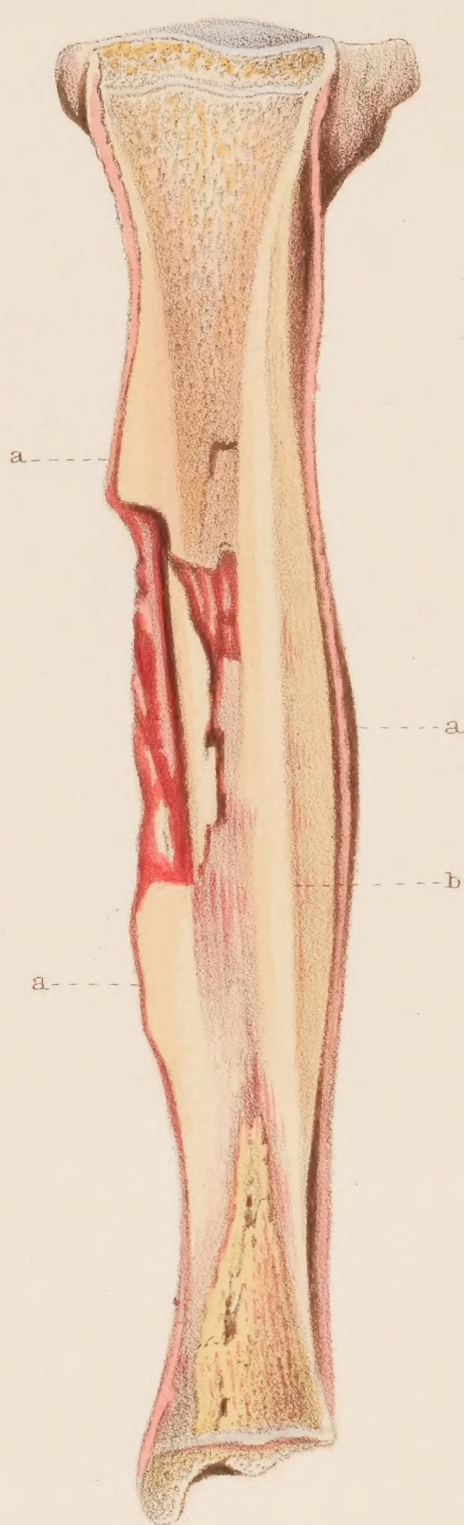


Fig. 4.



PLATE IX.

VARIETIES OF NECROSIS, REPARATIVE PROCESSES IN MAN AND ANIMALS*.

FIG. 1.—Section of a tibia from a young person, in which the entire shaft of the bone having perished, a new shaft is in progress of formation around it.

The perished shaft of the tibia is separated from its articular ends.

The new bone is sufficiently formed to connect together the articular ends of the old bone; thus was the firmness of the limb maintained, notwithstanding that the old bone was completely separated from its articular ends.

a—The new bone covered by the periosteum which invested the old bone.

b—The old bone. A layer of soft and very vascular granulations intervenes between it and the new bone.

c—Portion of skin, with the subjacent soft parts, through which a fistulous passage extends to the dead bone. A bristle is introduced into this passage.

d, d—Granulations arising from the surface of the living bone, where the dead bone had separated from it.

In this instance the new shaft of the bone was formed by the periosteum of the old bone. In most specimens of necrosis, roughnesses and excavations are observed upon the surface of the dead bone, apparently produced by the detachment of minute portions of its outer lamellæ in connexion with the periosteum; and it has been considered that these fragments of the old bone are the nuclei of ossification in the formation of the new bone. But in the specimen above described, the outer surface of the old and dead bone is unaltered: it presents throughout its natural smoothness. Therefore, in this example of necrosis, and in others like it, the view to be taken of the formation of the new bone is, that it is effected by the periosteum of the old bone, in the same way that, in animals, the new shaft of a bone is formed when the death of the old shaft has ensued from the destruction of its medullary tissue. Examples of this process in animals, obtained by experiment, are already adduced.

For the possession of this valuable specimen of necrosis I am indebted to Sir James M'Grigor. It is preserved in the Museum of St. Bartholomew's Hospital.

FIG. 2.—Necrosis of the os calcis, which was probably preceded by abscess in the centre of the bone.

a—The dead bone in progress of separation. An irregular aperture leads to a cavity in its centre, which it is presumed was the seat of abscess.

FIG. 3.—Section of the tibia of a dog, in which necrosis of part of its walls has ensued from the application of caustic to its surface.

a, a, a—New osseous substance deposited beneath the periosteum, adding to the thickness of the walls of the bone.

b—Line of division between the new osseous substance and the original walls of the bone.

c—Perished portion of the walls almost completely separated from the living bone.

It will be observed that, as a consequence of the loss of part of the walls of the bone, they are thickened through the rest of their extent; but that this process of thickening and strengthening of the walls has taken place in the greatest extent opposite to the vacant space where a portion of them had perished and exfoliated. These results of the experiment remarkably agree with the following views of Mr. Hunter:—"While Nature is busied in getting rid

* Treatise, Part I. Chap. vii.

of that part of the bone which is dead she is laying on additional bone on the outside, the intention of which seems to be that of keeping up the strength of the bone, which would, without this addition, be lessened by the loss of substance. This opinion is, I think, supported by this circumstance seldom occurring in this manner in any bones but those of the lower extremity which support the animal *."

FIG. 4.—Front surface of the tibia of an adult, in which there is necrosis of part of the outer lamellæ.

a—The dead bone porous, and of a black colour.

b—Groove of separation between the dead and living bone.

c—New osseous substance deposited upon the living bone around the groove separating it from the dead bone.

The porous texture of the dead bone must be attributed to the actions of disease. Accordingly, this is an instance of the death and exfoliation of a portion of bone which had previously been the seat of disease.

PLATE X.

VARIETIES OF NECROSIS †.

FIG. 1.—Necrosis of the whole shaft of the tibia in a young person.

a, a, a—The new bone in progress of formation.

b, b—The dead shaft of the tibia, in progress of separation from its articular extremities.

The dead bone presents, in its upper part and outer surface, roughnesses and excavations. In the view formerly held of the reparative processes in necrosis, these roughnesses and excavations would be ascribed to the agency of the granulations from the adjacent parts upon the dead bone; but in the modern view of this subject, they would be ascribed to the detachment of portions of the outer lamellæ of the bone in connexion with its periosteum.

FIG. 2.—Necrosis of the entire body of the lower jaw.

a, a—Lines of separation of the dead bone.

b, b, b—New bone in progress of formation.

From a man, aged twenty-three, who was attacked by fever, in the course of which mercury was administered by friction upon the limbs. Salivation ensued. Abscesses formed around the jaw, discharging a large quantity of foetid matter. He died, apparently exhausted by the irritation of these diseased processes.

FIG. 3.—Necrosis of part of the shaft of the tibia in an adult.

a, a—Portions of the dead bone apparently in progress of absorption.

b, b—Very vascular soft granulations occupying the space between the dead bone and the new bone which has formed around it.

c, c—The new bone in part formed.

This specimen of necrosis was exhibited by Mr. Abernethy at his Lectures, in confirmation of the views of Mr. Hunter, respecting the agency of granulations in the absorption of dead bone. The circumstances observed in the specimen to which Mr. Abernethy particularly referred, were the absorption of the dead bone only in certain situations where the soft granulations were in contact with it, whilst in other situations the dead bone had apparently undergone no diminution.

* Lectures on the Principles of Surgery.

† Treatise, Part I. Chap. vii.

Fig. 1.



Fig. 2.



Fig. 3.



Fig. 1.



Fig. 2.



Fig. 3.

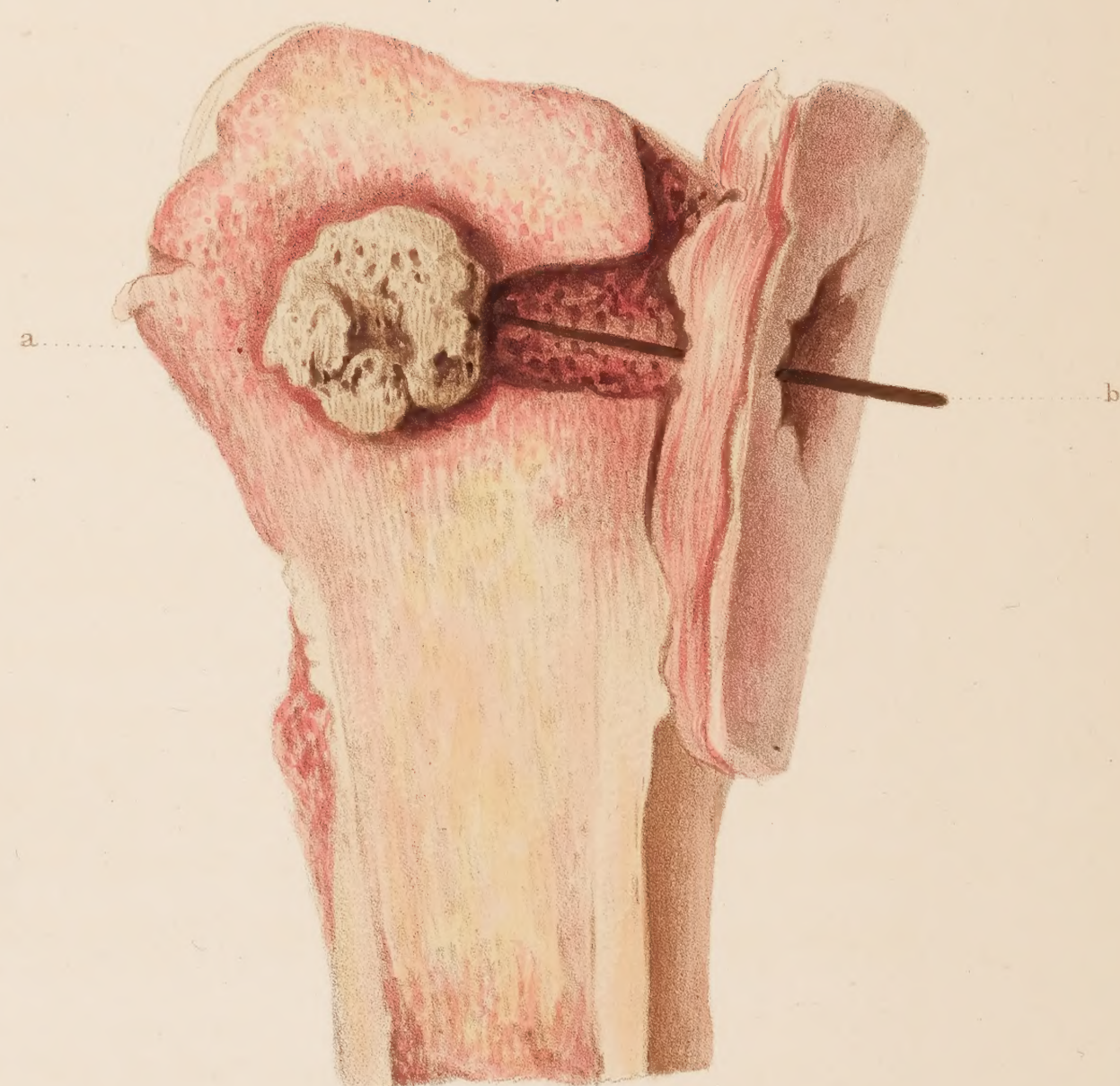


PLATE XI.

VARIETIES OF NECROSIS *.

FIG. 1.—Necrosis of the entire shaft of the femur in a youth sixteen years of age.

The disease had been in progress a year and a half when the limb was amputated, through the trochanter major, by Mr. Lawrence, in St. Bartholomew's Hospital.

The shaft of the bone has separated from its articular extremities. The walls of the cavity in which it is contained are formed in part by new bone, and in part by the surrounding muscles and other soft structures of the limb.

a—The trochanter minor.

b—The new bone. This is continued into the upper part of the femur ; but it is connected only by soft substance with the condyles.

c—Very vascular membrane lining the new bone.

d—The muscles and other soft structures connecting the upper and lower portions of the femur.

e—Portion of skin.

f—The exfoliated end of the shaft of the bone protruding through an ulcerated opening in the skin.

g—Part of the articular cartilage of the condyles ; the remainder of the articular cartilage of the knee joint had been absorbed.

h—Vacant space between the upper and lower portions of the new bone.

In this example of necrosis, the consequences are observed which ensue when the shaft of a bone is detached from its articular ends before the formation of the new bone is sufficiently advanced for it to become the medium of connexion between them, and thereby restore firmness to the limb. Under such circumstances, it is to be expected that the articular ends will become approximated, with shortening and distortion of the limb ; it besides often happens, as in the present case, that the exfoliated end of the shaft becomes protruded through an ulcerated passage in the soft parts and integuments.

The amputation was in this instance rendered necessary by the exhausting influences of the extensive suppuration in the thigh, also of the suppuration, and ulceration of the cartilages, in the knee joint, threatening the speedy destruction of life.

The history of this case has been recorded by Mr. Lawrence in the sixth volume of the Medico-Chirurgical Transactions.

FIG. 2.—Section of the lower part of a radius, in which there is necrosis of the cancellous texture composing its articular end.

a—The dead bone in progress of separation.

b—Groove between the dead and living bone.

c, c—Osseous substance deposited upon the living bone, adjacent to the groove separating it from the dead bone.

This is an example of necrosis not of frequent occurrence in the cancellous texture of bone. It exhibits the ordinary phenomena of exfoliation, namely, the channel formed between the living and dead bone, and the osseous deposit upon the living bone adjacent to this channel.

FIG. 3.—Section of the head and of part of the shaft of a tibia, in which there is necrosis of a portion of the cancellous texture within the head of the bone, close to the knee joint.

a—The piece of dead bone still connected with the living bone.

b—Probe passed through a fistulous passage, extending through the soft parts and into the head of the tibia, to the dead bone.

* Treatise, Part I. Chap. vii.

This disease occurred in a female : it commenced at the age of sixteen years, and it had been sixteen years in progress when the limb was removed. The disease arose without obvious cause : it is uncertain whether at its commencement there was abscess in the bone, or necrosis of its cancellous texture. During its progress, many small pieces of dead bone had been extracted through the fistulous passage ; but the source of irritation continued, as there yet remained dead bone not separated from the living bone. At length the irritation extending from the head of the tibia to the knee joint, caused the destruction of its structures, accompanied by such severe constitutional derangement, that, for the preservation of life, it became necessary to remove the limb.

It will be observed that the piece of dead bone within the head of the tibia is situated so near to the knee joint, that the removal of it by operation could only have been done at the risk of opening the joint.

PLATE XII.

VARIETIES OF EXOSTOSIS *.

FIG. 1.—Section of an osseous tumor with a cavity in its centre, growing from the head of the tibia. The thick walls of this cavity are formed by solid osseous substance. From the cavity, purulent fluid was abundantly discharged through an aperture in its walls. The cavity in the tumor does not extend to the interior of the head and shaft of the tibia.

If the cavity in this osseous tumor had extended to the interior of the head and shaft of the tibia, the disease might have been regarded as an abscess which originated within the bone, and during its enlargement had become surrounded by thick osseous walls, similar to the disease represented in Plate VI. But it is more probable that the tumor had been at first a solid osseous growth from the head of the tibia, and that suppuration had taken place in the centre of the tumor, followed by ulceration of part of its walls, permitting the escape of the matter from its interior.

FIG. 2.—An exostosis which was removed by operation from the anterior border of the bicipital groove in the humerus. The tumor consists in one situation of a dense yellow osseous substance, and in another of cancellous texture, filled by an oily fluid.

This is an example of the outgrowth or circumscribed hypertrophy of bone which is not preceded by a primordial cartilage. Of this character are, in general, the osseous tumors which grow from the natural prominences, processes or ridges of bones. Such outgrowths or circumscribed hypertrophies of bone do not ordinarily increase to so large a size as to require removal.

FIG. 3.—Bone of the second phalanx of a great toe, from the upper surface of which, near its extremity, an exostosis has arisen.

FIG. 4.—Extremity of a great toe which was amputated between its first and second phalanges, on account of an exostosis arising from the bone of the second phalanx. The tumor is of a rounded form, and it projects from beneath the front and lateral borders of the nail.

The exostosis which grows from the last bone of a toe, and most frequently of the great toe, generally has fibrous tissue alone for its base and primordial structure. I have, however, seen an instance of this exostosis covered by a thin layer of cartilage. This exostosis usually grows from the upper surface or margin of the last bone of the toe. As it increases, it elevates the nail and projects from beneath its front and lateral borders in the manner represented in Fig. 4.

* Treatise, Part II.

Fig. 1.



Fig. 2



Fig. 3.



Fig. 4.



Fig. 1.

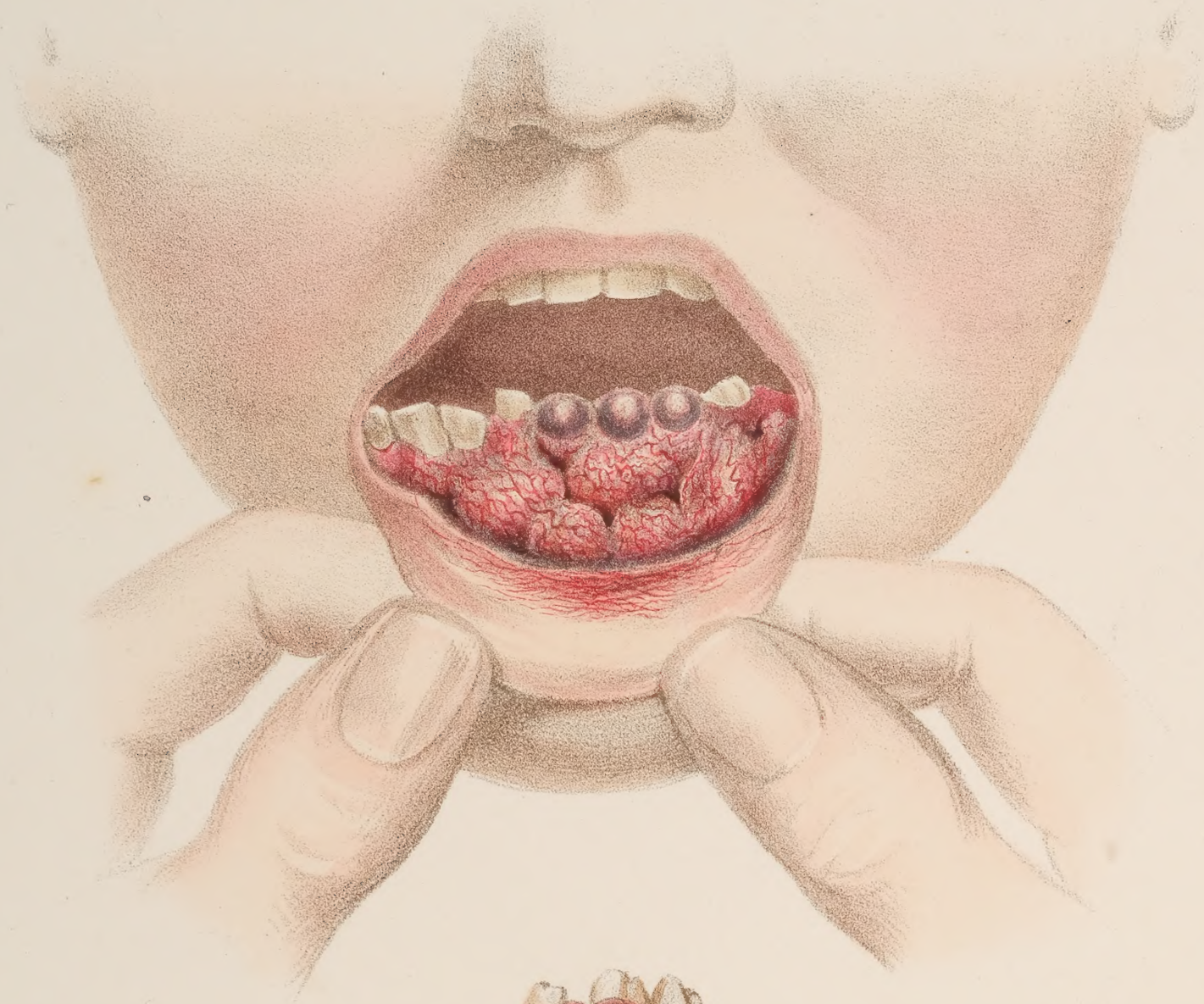


Fig. 2.



Fig. 3.



Fig. 4.

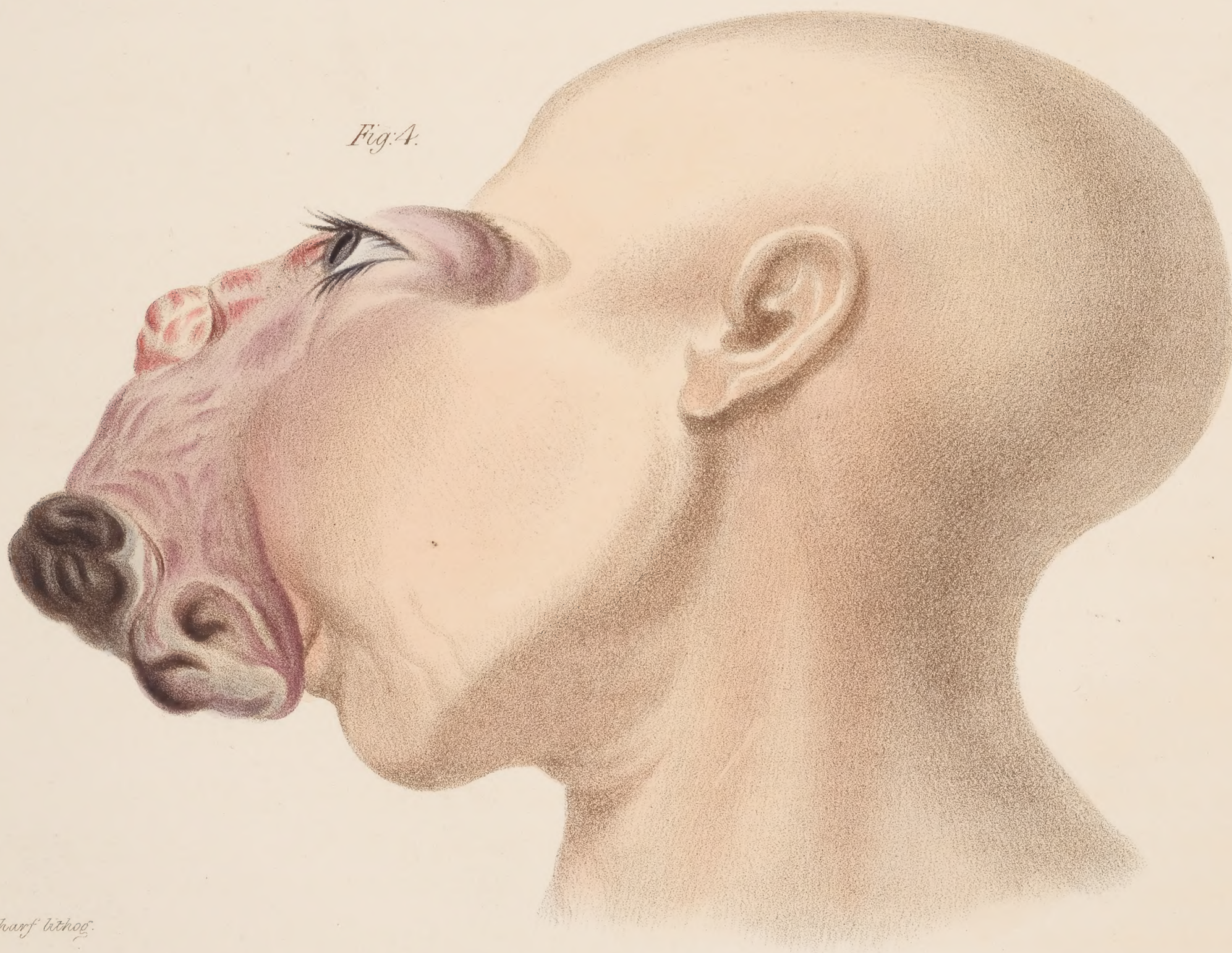


PLATE XIII.

GROWTH OF SOFT, VERY VASCULAR TISSUE FROM THE INTERIOR OF THE LOWER JAW—PULSATING TUMOR OF THE HUMERUS—GROWTH OF SOFT VERY VASCULAR TISSUE, AND OF CARTILAGINOUS SUBSTANCE FROM THE BONES OF THE UPPER JAW.

FIG. 1.—Growth from the cancellous texture of the front part of the lower jaw, extending upwards, through the alveolar border of the jaw, into the mouth. The lip is everted to show the tumor protruding into the mouth. Three of the incisor teeth having been removed, the situation of their sockets is indicated by depressions in the upper border of the tumor. The surface of the tumor, covered by the mucous membrane of the mouth, is of a reddish purple colour.

FIG. 2.—Portion of the jaw, with the growth from it, which was removed by operation. The growth is soft, and dark coloured, apparently from congestion with venous blood; its characters resembled those of erectile tissue.

This disease occurred in a boy eight years of age, who was in St. Bartholomew's Hospital, under the care of Mr. Lloyd. The disease had been four years and a half in progress when the operation of its removal was performed. The entire front of the jaw was taken away without any external wound. This was effected by everting the lip, and then separating the soft parts from each surface of the jaw to a sufficient extent to allow the division of the bone beyond the limits of the disease. The patient was seen by Mr. Lloyd many years after the operation, and there had been no return of the disease.

FIG. 3.—Tumor originating in the humerus, which presented, in every part of its surface, the regular and forcible pulsation of aneurism. The tumor occupies the upper two-thirds, and the entire circumference of the arm. Its surface is irregular, and there are large subcutaneous veins ramifying upon it. Compression of the subclavian artery stopped the pulsation of the tumor, and lessened its tension. The pulsation of the brachial artery below the tumor was distinct.

This disease occurred in a female sixty-two years of age, and it was about three years in progress. During the latter part of this period, the humerus spontaneously broke in its centre. The health of the patient failed, and she gradually sank.

The tumor was found to consist of a moderately firm gelatinous substance, originating in the humerus, great part of the shaft of which had disappeared. In the centre of the gelatinous substance, there was a large cavity filled by serous fluid. The brachial artery with the accompanying veins were attached to one side of the tumor, but they were perfectly healthy. Water injected into the posterior circumflex artery escaped from the cut surface of the tumor only in small quantity, showing that the vessels ramifying through it were not of large size.

In this example of the pulsating tumor of bone, the pulsation could not be ascribed to any other cause than the contiguity of the tumor to the brachial artery.

FIG. 4.—Exterior of the face of a boy fourteen years of age, enlarged and distorted by a growth, which, originating in the bones of the upper jaw, filled the cavities of the nose and orbits, and extended into the cavity of the cranium.

The left nostril is here seen distended by the growth. Part of the skin covering it has ulcerated. The surface of the tumor projecting below the nostril has sloughed.

This growth is composed of two distinct substances. The portion of it which fills the nostrils consists of a soft, very vascular tissue; whilst the portion of it occupying the deeper cavities of the nose and the orbits consists of cartilaginous substance.

The interior of this tumor is represented in Plate XVII. Fig. 3.

PLATE XIV.

VARIETIES OF EXOSTOSIS—SANGUINEOUS TUMOR OF BONE.

FIG. 1.—Section of an exostosis situated upon the front part of the femur. Beneath the exostosis, the walls of the femur are unaltered. The texture of the exostosis in no respect differs from the healthy cancellous texture of original bone.

Such a form of exostosis as is here represented originates in irritation of the periosteum, followed by the deposition of osseous laminae in its tissue. As these laminae increase, they coalesce, and become united to the surface of the subjacent bone. Such osseous growths have no primordial cartilage; in this respect they resemble the osseous tumors which are outgrowths, or circumscribed hypertrophies of bone.

FIG. 2.—Section of an exostosis which has grown from the lower and front part of the femur.

This exostosis originated in the cancellous texture of the femur, and at its base is in part covered by the walls of the bone. The texture of the exostosis is cancellous. The larger and prominent portion of the tumor was removed during life. The letter (*a*) refers to the surface of the tumor exposed by the operation.

Such a form of exostosis is an outgrowth of bone, not preceded by a primordial cartilage.

This exostosis was situated so near to the knee joint that the synovial membrane of the joint, even moderately distended by fluid, extended upwards upon the tumor. As the tumor was increasing with much irritation in the surrounding parts, its removal was undertaken. But there had been fluid within the joint, and although at the time of the operation the fluid had disappeared, yet the synovial membrane had not recovered its former limits, and, consequently, in the exposure of the tumor necessary for its removal, the knee joint was opened.

FIG. 3.—Sections of an exostosis which was removed by Mr. Hodgson, in the hospital at Birmingham, from the lower part and inner side of the femur of a girl fourteen years of age. The base of the tumor which was attached to the femur consists of cancellous osseous texture. The exterior, and most prominent portion of the tumor, consists of a mass of cartilage (*a, a*) of considerable thickness.

Here the mode of growth of such a form of exostosis is observed to be by the ossification of the cartilage at its base.

FIG. 4.—Portion of an osseous tumor which grew from the femur. Another portion of this tumor consisted of dense fibrous tissue. The osseous portion of the tumor here represented is of a grey colour, and is composed of delicate fibres, and thin lamellae. The fibres are mostly arranged as cancelli, and the lamellae are disposed in parallel lines.

Such an osseous tumor is, I believe, in all instances, a growth from diseased bone; it is so certainly in the several examples of this tumor preserved in the museum of St. Bartholomew's Hospital.

FIG. 5.—Cyst formed by the expansion of the condyles of the femur. The cyst was filled by partly fluid and partly coagulated blood; its walls are composed of a thin shell of bone covered by healthy periosteum. The inner surface of the cyst presents a sort of network of fleshy cords, somewhat resembling the interior of the ventricles of the heart. And, in the recent state, there were small portions of soft substance resembling the deposit of encephaloid disease, projecting from the inner surface of the cyst.

a—Part of the cyst reflected to show the network of fleshy cords projecting from its internal surface.

In the femur, beyond the limits of the cyst, there were minute effusions of blood into the osseous tissue, giving to it an ecchymosed appearance, and in the tibia, throughout its shaft, the osseous tissue presented the same characters.

This disease occurred in a man thirty years of age. It had been two years in progress, and was accompanied throughout by severe pain. The limb was amputated in the middle of the thigh. The stump healed soundly, and there was no recurrence of the disease when I saw this patient several years after the operation.

Although this disease is stated to constitute the sanguineous tumor of bone, yet, from the character of the soft deposits upon the inside of the cyst, doubt may be entertained whether it is not a variety of encephaloid disease.

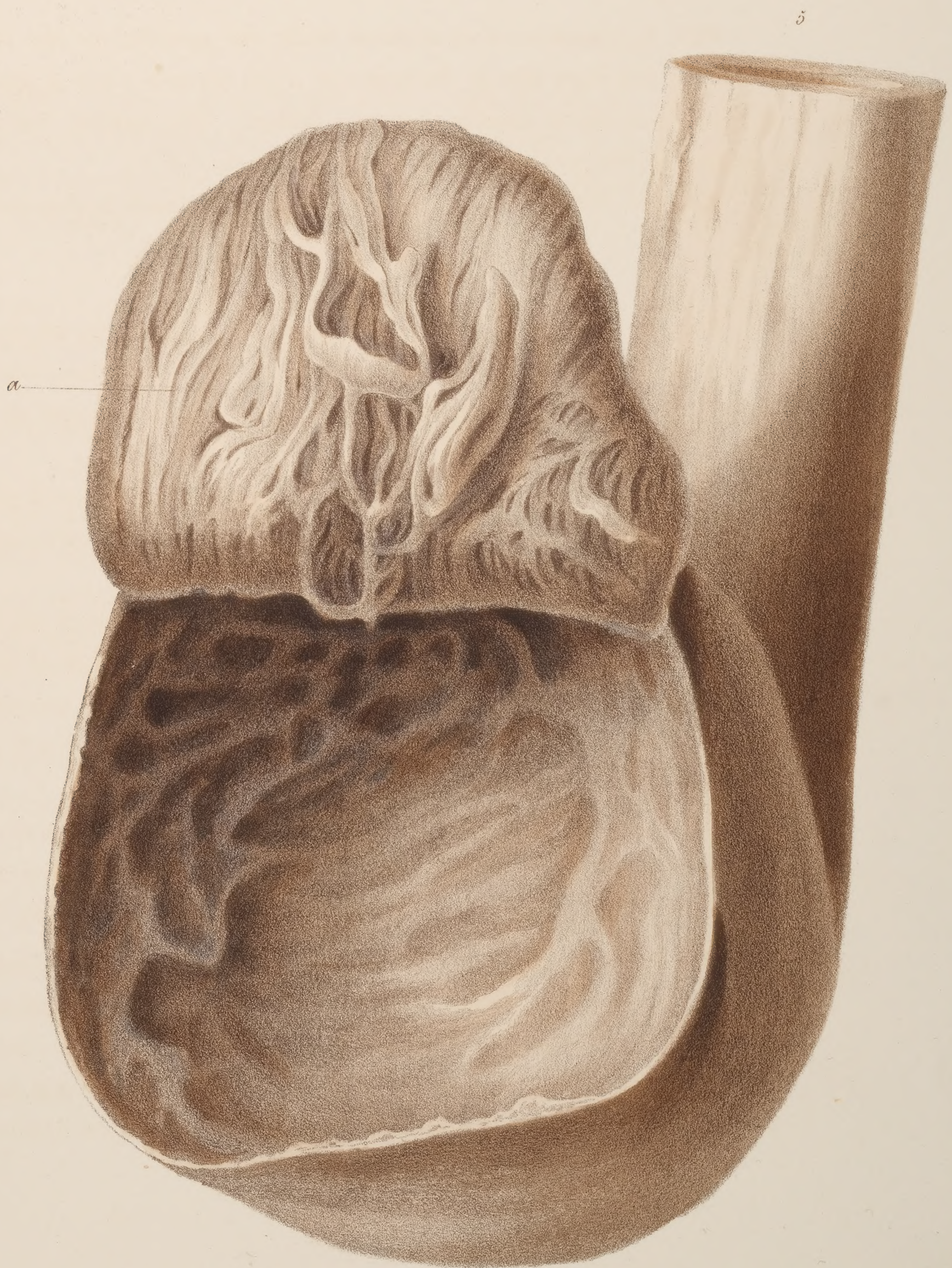
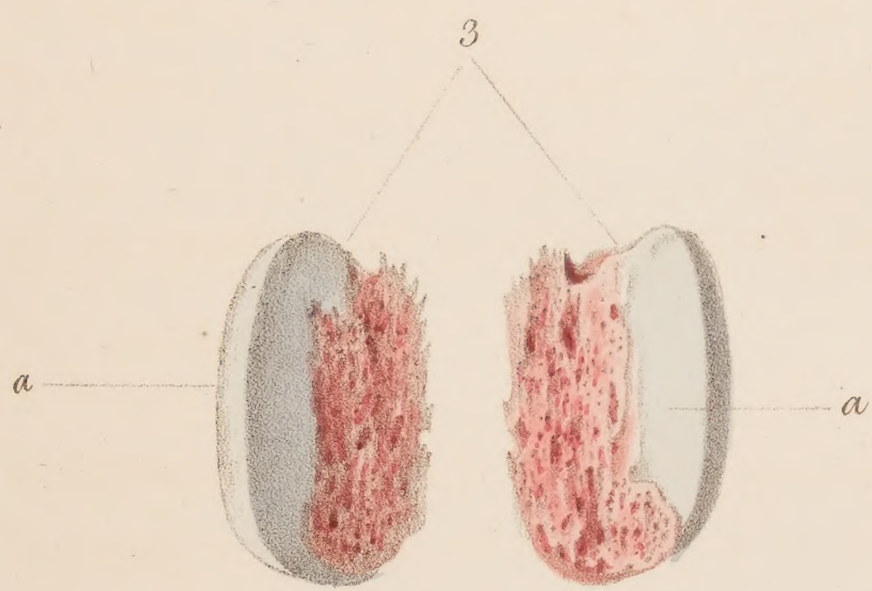
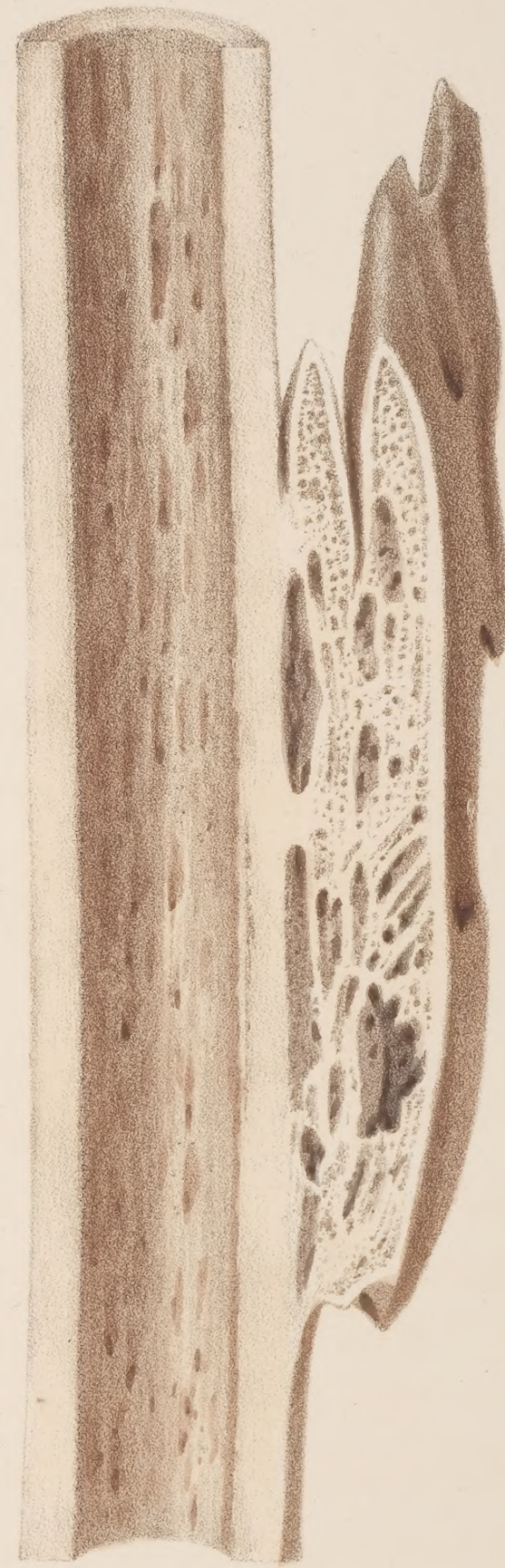
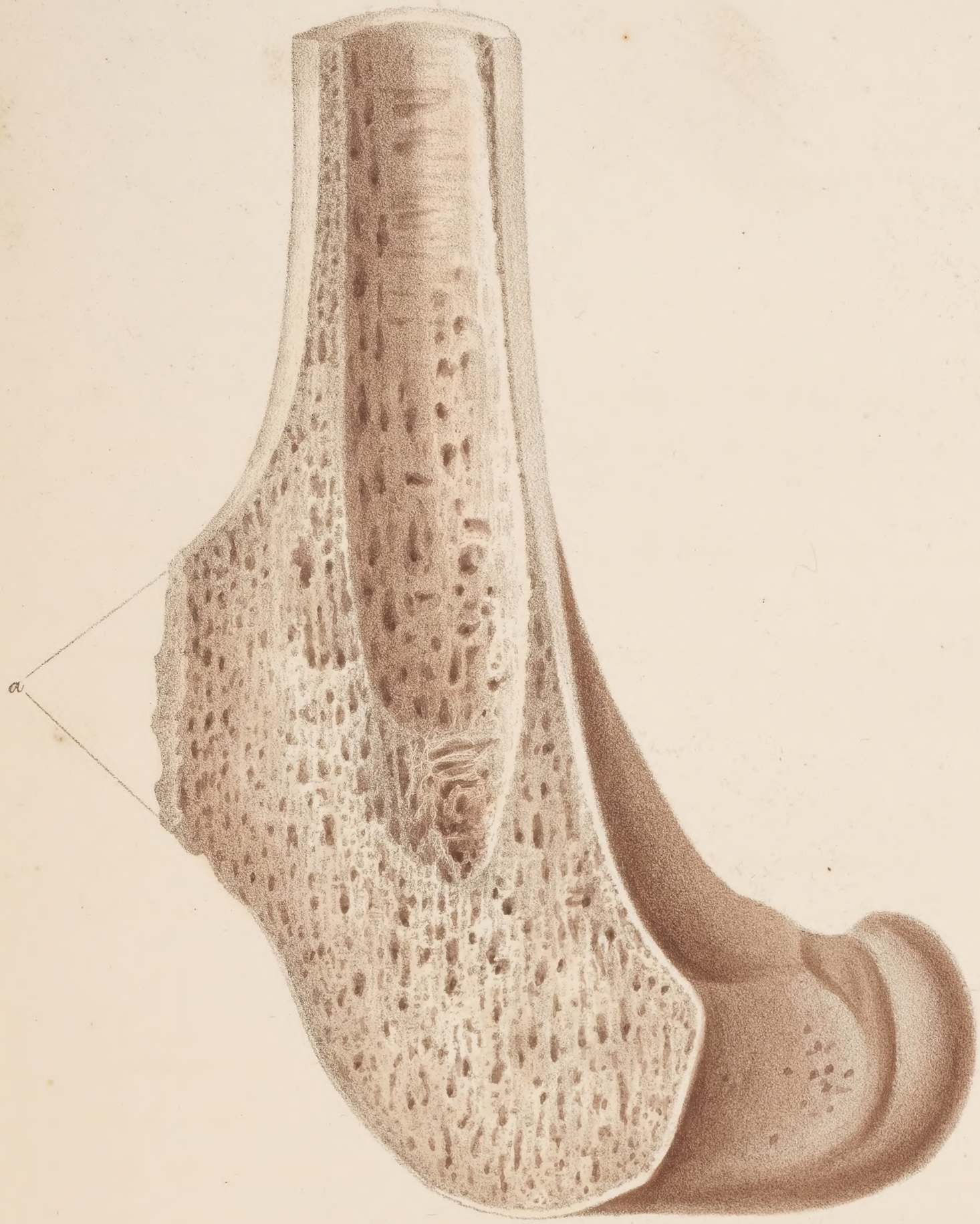




Fig. 1. 2. W. I. Baynton del.
Fig. 3. A. M. M. Whinnie del.

G. Schrey lithog.

PLATE XV.

MALIGNANT DISEASE OF THE TIBIA, ORIGINATING IN ITS PERIOSTEUM—GROWTH OF CARTILAGE AND
OF A SOFT VERY VASCULAR TISSUE FROM THE TIBIA.

FIG. 1.—Section of the lower part of a tibia, in which there is a soft, very vascular fungus growing out of the cancellous texture, also from the internal surface of its posterior wall, and from the adjacent periosteum.

This disease occurred in a man aged thirty-eight. It had been many years in progress, and was the consequence of repeated injuries to the front of the leg, followed by ulceration of the periosteum and bone, with the growth of a fungous excrescence from the diseased surfaces. The fungus had been completely removed by operation, leaving a large vacancy in the bone extending to its posterior wall, and to the cancellous texture of its articular extremity. Reproduction of the fungus from the exposed surfaces quickly ensued.

FIG. 2.—Section of the lower part of a tibia, in which there is a fungus growing from the periosteum, of the same character as that which is represented in Fig. 1. The periosteum with the fungus is in part separated from the tibia. The periosteum is thickened, of a soft flocculent texture, and it was loosely united to the bone. Beneath the diseased periosteum, the bone is rough from absorption in some parts, and from osseous deposits in others.

This disease occurred in a man aged fifty. It had been twenty years in progress, and had originated in injury to the front of the leg, followed by abscesses and ulceration in the soft parts, and after several years by the growth of a fungous excrescence from the periosteum.

The two preceding views are illustrations of malignant disease in periosteum and bone, the consequence of repeated injuries by violence to the investing soft parts. Abscesses and ulceration ensuing in these, the ulceration thence extended through the periosteum, and deeply into the bone, accompanied by the growth of a peculiar fungous excrescence from the diseased parts. This is represented to be a malignant disease, as it has been found incurable. In instances where all the textures of the limb to which the disease extended had been completely removed by operation, yet the fungus was quickly reproduced from the exposed surfaces.

FIG. 3.—Section of the upper half of the shaft of a tibia, and of a tumor which has grown around it. One half of the tumor is composed of cartilaginous and osseous substance; its other half is composed of a soft and very vascular tissue. The cartilage is disposed in nodules, and in texture it resembles foetal cartilage. The osseous substance is situated at the base of the tumor, and it is consolidated with the walls of the tibia.

This tumor of bone is remarkable in respect to its structure, one half of it consisting of an ossifying enchondroma, its other half consisting of soft, very vascular substance resembling a form of erectile tissue. Another example of the combination of the same varieties of morbid growth occurs in a tumor filling the nasal cavities, and extending to the interior of the skull, represented in Plate XVII. Fig. 3.

Such combinations of morbid structure are illustrations of the difficulty experienced in deciding upon the nature of the tumors of bone by their outward characters, for these afford no indication of such modifications in the internal structure of the tumor as are here represented.

PLATE XVI.

REMARKABLE EFFECTS OF INFLAMMATION IN PERIOSTEUM AND BONE—DIFFUSE SUPPURATION IN BONE—
VARIETIES OF NECROSIS, EXOSTOSIS—FIBROUS TUMOUR WITHIN THE ANTRUM.

FIGS. 1, 2, 3, 4.—Bones of the elbow joint from a young person. The joint had long been the seat of inflammation, which had caused ulceration of its cartilages and of the surfaces of its bones. Inflammation, extending to the adjacent bones, has occasioned the formation of a perfect wall of new bone around the adjacent portions of the humerus, radius, and ulna. This wall of new bone, consisting of an outer compact and of an inner cancellous texture, is, in each instance, formed between the periosteum and the walls of the original bone, to both of which it is united.

The remarkable occurrence is here presented of the formation of an entire new osseous wall around the humerus, radius, and ulna, for some way beyond the elbow joint, notwithstanding that the bones had preserved their vitality. In fact, the reparative processes of necrosis have here taken place without the preceding death of bone to account for them.

FIG. 1.—Outer surface of the osseous wall formed around the humerus.

a—Periosteum reflected from the new osseous wall.

b—Outer surface of the new bone, which is very vascular.

FIG. 2.—Internal surface of a section of the humerus, and of the new osseous wall surrounding it.

a—Medullary texture of the humerus.

b, b—New osseous wall.

c—Periosteum reflected from the new osseous wall.

FIG. 3.—Internal surface of a section of the ulna, and of the new osseous wall surrounding it.

a—Medullary texture of the ulna.

b, b—New osseous wall.

FIG. 4.—Internal surface of a section of the radius, and of the new osseous wall surrounding it.

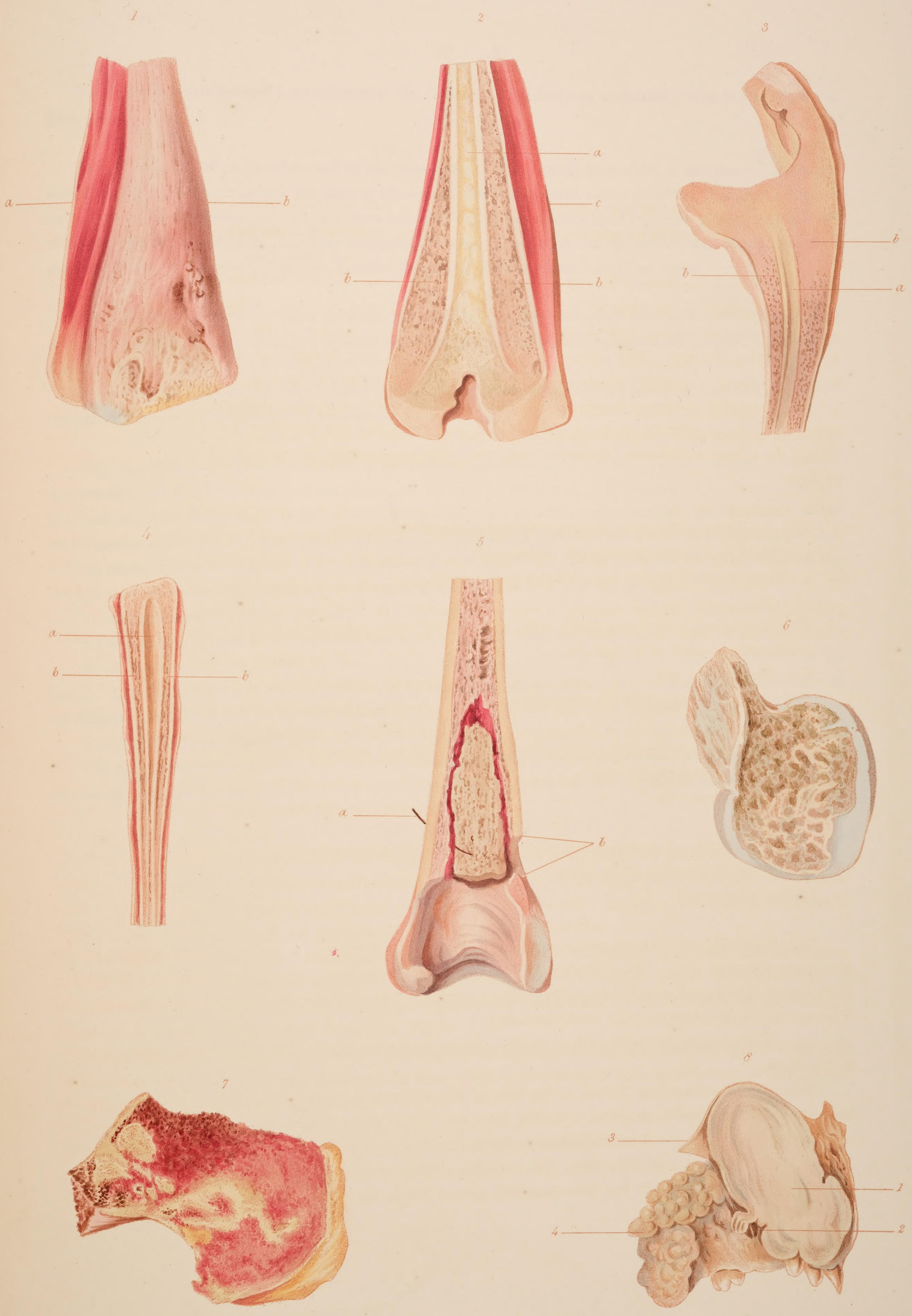
a—The medullary texture of the radius.

b—New osseous wall.

FIG. 5.—Section of the lower part of a tibia, in which there is necrosis of a portion of the cancellous texture just above the ankle joint. The exfoliation of the dead bone is completed. The channel separating it from the living bone is filled by soft granulations. The cavity in which the dead bone lies communicates with the ankle joint. The cartilages of the joint are almost wholly destroyed.

a, b—Ulcerated passages in the walls of the tibia, leading to the dead bone. Into one of these passages a bristle is introduced.

Necrosis in the cancellous texture of the tibia in this case commenced when the patient was seven years of age, and the inflammatory processes, extending from the interior of the tibia to the ankle joint, occasioned the destruction of its cartilages. A marked feature in the case had been the occurrence of numerous abscesses successively forming around the lower part of the tibia. The formation of these abscesses was sufficiently explained by reference to the source of irritation which had been constantly present within the tibia; namely, the perished portion of its cancellous texture.



For this specimen of necrosis I am indebted to Mr. Hodgson. The limb was amputated by him in the hospital at Birmingham.

FIG. 6.—Section of an exostosis, and of the inferior angle of the scapula from which it has grown. Connected with the upper part of the tumor is the piece of the scapula that was removed with it; and the cancellous texture of the scapula is here continuous with the cancellous texture of which the exostosis chiefly consists. A layer of cartilage of irregular thickness encloses its cancellous substance. It might be expected that the cartilaginous capsule, becoming gradually thinner, would wholly disappear, and that the growth of the exostosis would then cease.

FIG. 7.—Section of an os calcis in which purulent fluid is diffused through part of the cancellous texture. Around the patches of suppuration, the inflamed cancellous texture is dark-coloured, from the congested state of its blood-vessels.

From a man seventy years of age, in whom, without evident cause, inflammation, followed by suppuration, extended through all the bones of the tarsus and metatarsus.

FIG. 8.—Section of a fibrous tumor filling the antrum, and of the portion of the superior maxillary bone which was removed with it. The tumor had not penetrated the walls of the antrum. Its attachment was to the lower and front wall, along the line of the alveolar process. The tumor, as it gradually enlarged within the antrum, had detached the membrane lining of the cavity from its bony walls. The tumor consists of dense fibrous tissue. Within its base, and just above the alveolar process, is the black carious fang of a tooth. Hence it is probable that the irritation of this diseased tooth gave rise to the growth from the adjacent part of the bony wall of the antrum.

1.—Cut surface of the fibrous tumor filling the antrum.

2.—Black carious tooth at the base of the tumor, just above the alveolar process.

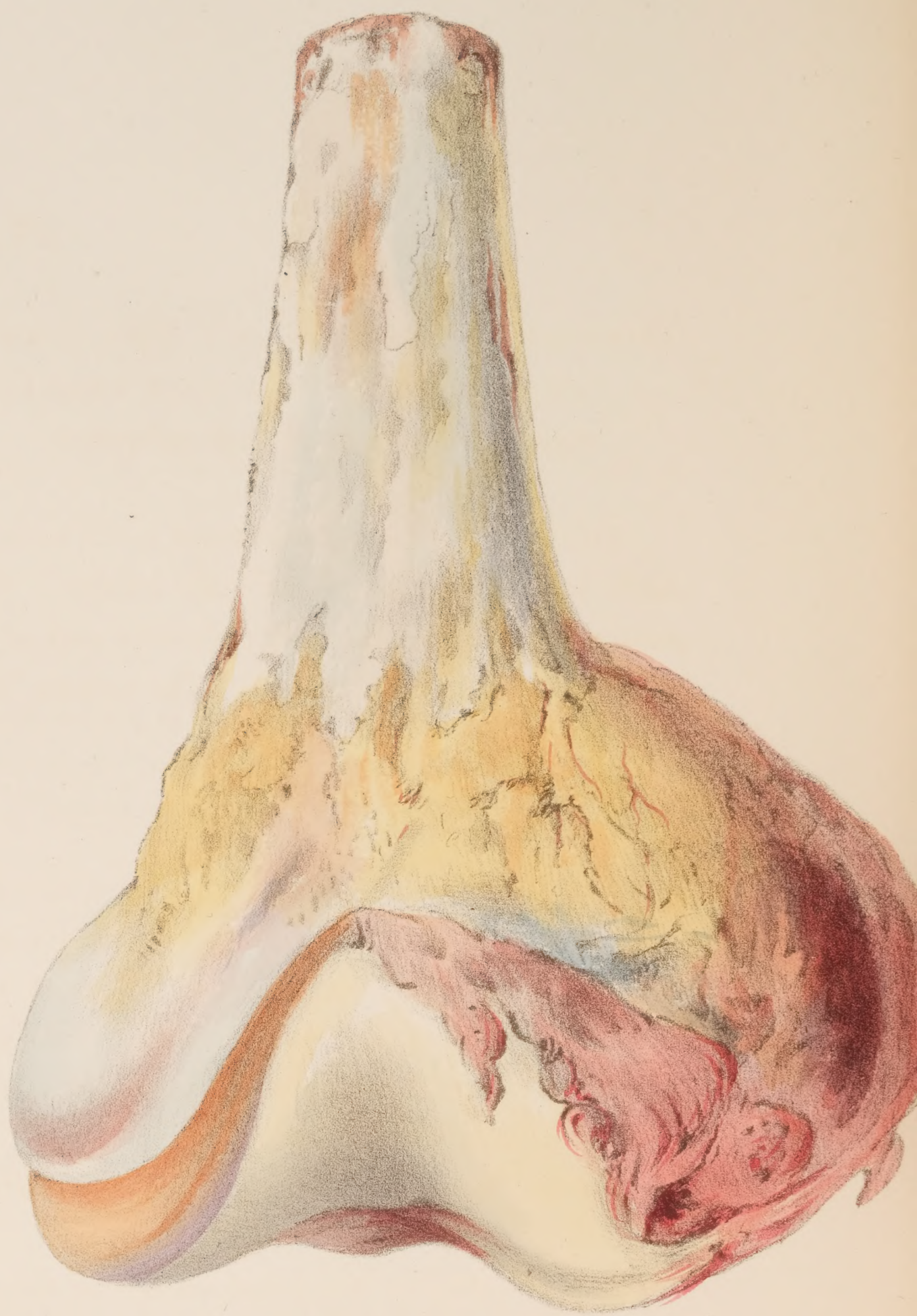
3.—Membrane lining of the antrum, detached from its bony walls during the gradual enlargement of the tumor. Thus the membrane became applied upon the upper part and sides of the tumor, much in the same way that the reflected pericardium is applied upon the heart.

4.—Healthy adipose tissue adjacent to the walls of the antrum.

For the representation of this specimen I am indebted to Mr. Luke, of the London Hospital, by whom the removal of the fibrous tumor, with part of the superior maxillary bone, was performed with a successful result.



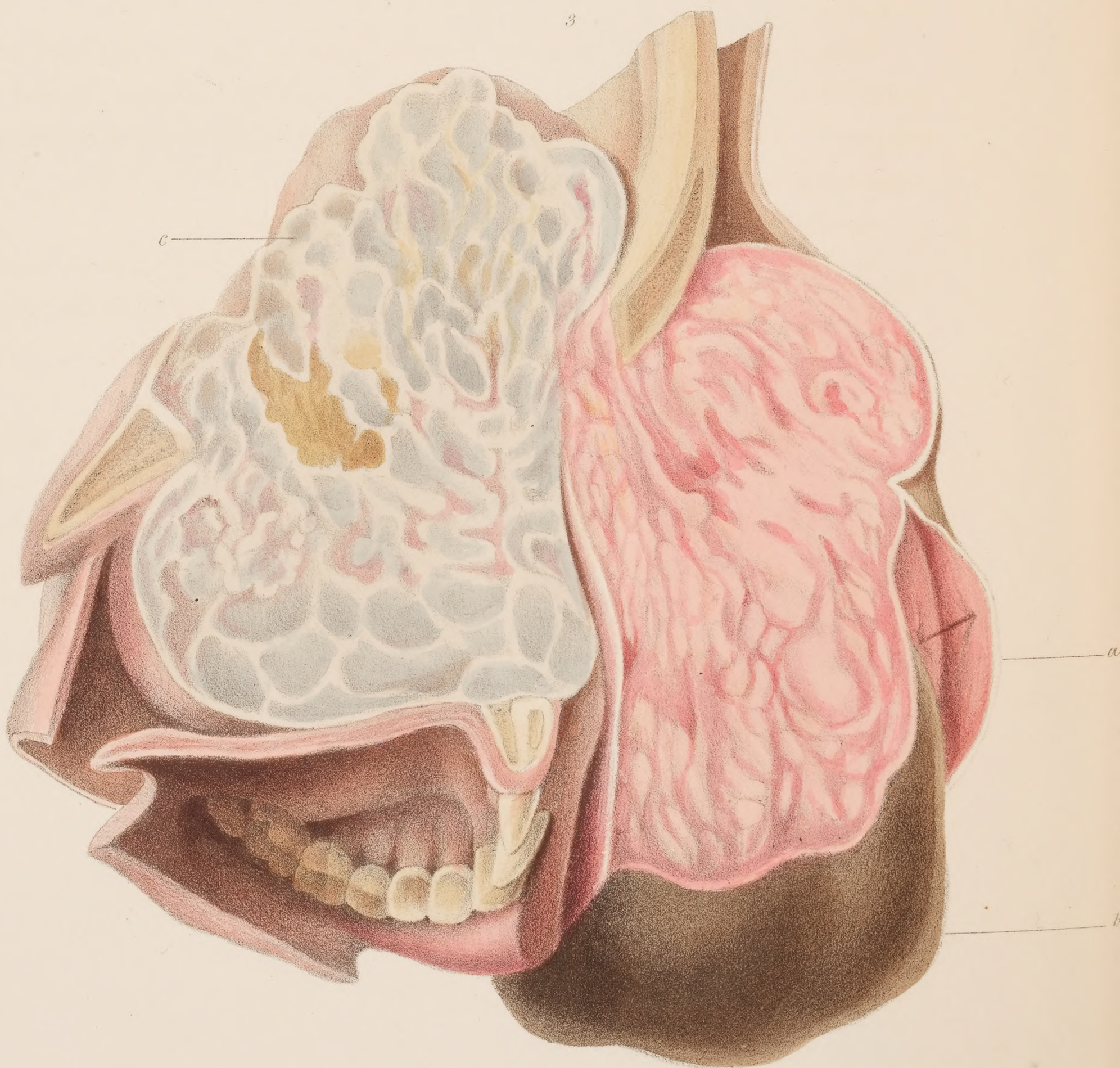
W.A. Delamotte del.



W.A. Delamotte del.



J. Perry del. et lith.



Hulmandel & Walton Lithographers

PLATE XVII.

ENCEPHALOID SUBSTANCE IN A CYST, FORMED BY EXPANSION OF THE LOWER END OF THE FEMUR—
ENCHONDROMA AND A SOFT VASCULAR SUBSTANCE ORIGINATING IN THE BONES OF THE FACE—
HARD CARCINOMA IN THE HUMERUS.

FIGS. 1, 2.—Large cyst formed in the lower part of the femur by the removal of its cancellous texture, and chiefly by the expansion of its inner condyle. The walls of the cyst consist of a thin shell of bone covered by periosteum, except at the most prominent part of the inner condyle, where the bone is absorbed, and the wall of the cyst consists of periosteum alone. The contents of the cyst are blood and encephaloid substance enclosed in cells.

FIG. 1.—Exterior of the cyst.

FIG. 2.—Section of the cyst displaying its contents.

This disease occurred in a man aged twenty-seven. It had been eleven months in progress, and was accompanied by severe pain. The enlargement of the knee joint which it occasioned, resembled, in its outward characters, the ordinary enlargement of it from thickening of the synovial membrane.

In the tibia of the same limb, the osseous substance of its shaft presented an ecchymosed appearance, from minute effusions of blood into its tissue.

The limb was amputated in St. Bartholomew's Hospital by Mr. Lawrence.

FIG. 3.—Section of a tumor, occupying the cavities of the nose and orbits, and extending into the cavity of the cranium. The tumor consists of two distinct structures. That part of it which fills the nostrils consists of a soft and very vascular tissue; whilst that part of it which fills the deeper cavities of the nose, the orbits, and extends into the cavity of the cranium, is of the character of enchondroma, with ossification of some of the lobes of cartilaginous substance.

This disease occurred in a boy fourteen years of age. It had been of very slow growth. Both eyes were protruded from the orbits. In one orbit the optic nerve had disappeared, and in the other the nerve was considerably elongated. The portion of the tumor which projects into the cavity of the cranium was imbedded in the anterior lobes of the cerebrum.

a—Part of the left nostril turned aside from the tumor.

b—Dark coloured sloughing surface of the tumor projecting below the nostril.

c—Cartilaginous portion of the tumor projecting into the cavity of the cranium.

An exterior view of this disease is contained in Plate XIII. Fig. 4.

FIG. 4.—Section of a humerus, in the medullary texture of which there are deposits of hard carcinomatous substance. A large carcinomatous mass has penetrated the walls on one side of the bone. A carcinomatous mass at the upper end of the bone has penetrated the walls through their entire circumference, and here, consequently, the bone gave way in the manner of a spontaneous fracture. Other small isolated carcinomatous deposits are scattered through the medullary texture.

This disease occurred in a man aged forty-five. The production of hard carcinoma in the right mammary gland was followed by productions of the same disease in both humeri, in the sternum, in the bodies of the vertebræ, also in the lungs and bronchial glands.

PLATE XVIII.

SCROFULA IN BONE—OSSEOUS CYST ATTACHED TO THE LOWER JAW—ENCEPHALOID DEPOSIT IN THE LOWER PART OF THE FEMUR.

FIG. 1.—Section of the bones of a knee joint, exhibiting the tuberculous stage of scrofulous disease. The bones are so soft as to be readily compressible by the fingers, in consequence of the removal of their earthy constituents: the articular cartilages are sound. The cancellous texture of the bones, consisting chiefly of animal matter, is in great part filled by granules of tuberculous substance.

FIG. 2.—Portion of an osseous cyst which was removed from the outside of the lower jaw. The cyst is lined by a thick, soft membrane. Part of this membrane (*a*) is turned downwards. The cuspidatus tooth (*b*) of the second set was found lying across the cyst, with its fang attached to the lining membrane by a soft, very vascular tissue.

This cyst formed in a man twenty-three years of age, and it had been three years in progress when it was removed. It was filled by a glairy fluid. One half of the cyst was formed by the thin osseous shell, its other half was formed by the walls of the lower jaw.

The operation of removing this cyst was undertaken with the impression that the tumor it formed was the consequence of disease in the jaw, accompanied by the expansion of its walls, and that the removal of part of the jaw would be required. But it was soon ascertained that the jaw itself was sound, and that the tumor was formed wholly by the cyst attached to the outside of the jaw. The cuspidatus tooth in its unnatural situation is to be regarded as the source of irritation, which had given rise to the production of the osseous cyst enclosing the tooth.

FIG. 3.—Section of the lower part of a femur, and of an encephaloid tumor which has grown from it. The encephaloid substance, in its colour and consistence, closely resembled healthy adult brain. In the circumference of the tumor there were small cavities in the encephaloid substance, filled by blood. The encephaloid substance is continued from the tumor into the cancellous texture of the femur, in which the disease appeared to have originated. The condyles of the femur have wholly disappeared, but their articular cartilage remains, and it forms the immediate covering of the tumor. The synovial membrane of the knee joint was unaltered.

a, a—The articular cartilage of the condyles of the femur forming the immediate investment of the tumor.

b—The encephaloid substance continued into the medullary tube of the femur.

FIG. 4.—Part of the shaft of the tibia from the same limb as the encephaloid tumor represented in Fig. 3. The periosteum is wholly removed, showing the discoloration of the surface of the bone, produced by minute effusions of blood into its substance.

PLATE 1. FIG. 1—Represents the remaining part of the shaft, with the neck and head of the femur from the same case as the two preceding specimens, showing the suppuration which ensued in the medullary and cancellous texture of the bone, after the amputation of the limb, which was performed in the middle of the thigh by Mr. Abernethy.

This example of encephaloid disease in the femur occurred in a man aged thirty-one. It had been in progress little more than a year. From the history of the symptoms affecting the knee joint, also from the characters of its enlargement, the disease was considered to be an ordinary instance of inflammation in the synovial membrane, producing increase of its thickness, and thus enlarging the joint. With this impression of the nature of the disease the limb was amputated.

On the fourteenth day after the operation, the patient was attacked by low fever with delirium, and at the same time he complained of severe pain in the upper part of the thigh, and in the hip joint. On the twenty-eighth day he died. Numerous small abscesses were found in the lungs, but no encephaloid deposit was discovered in any part of the body.



Fig. 1.

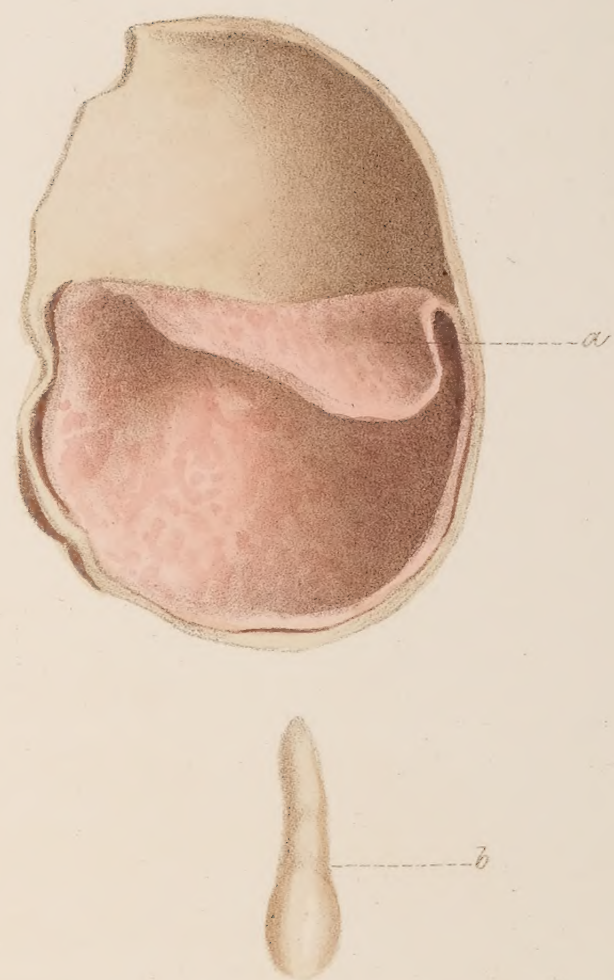


Fig. 2.

Fig. 3.



Fig. 4.





Fig. 1.



Fig. 2.



Fig. 4.

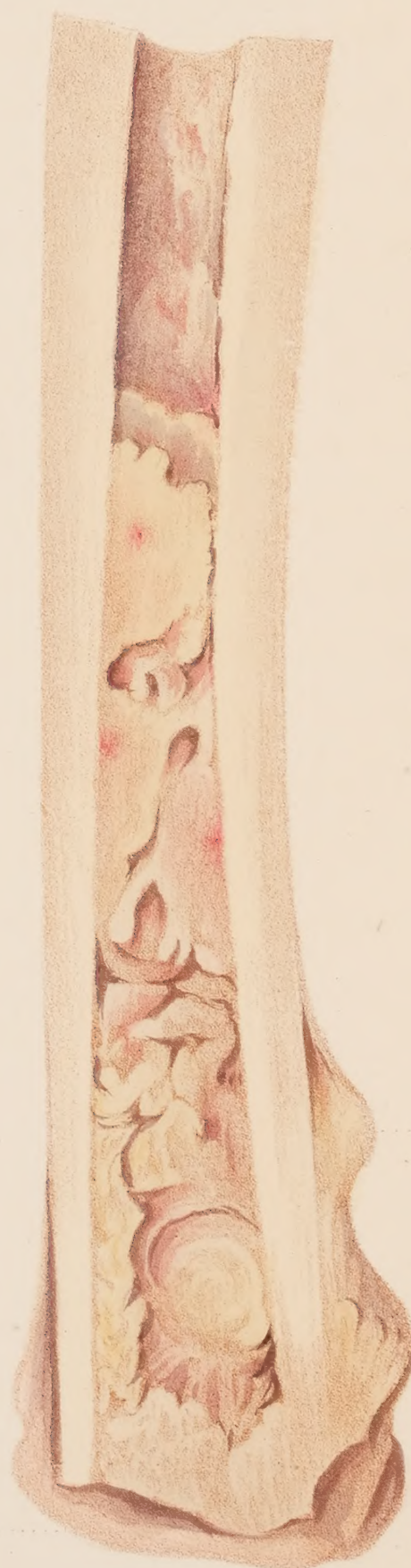


Fig. 3.

PLATE XIX.

ENCEPHALOID AND OSSEOUS GROWTHS FROM THE TIBIA, AND FROM THE FEMUR—CARTILAGINOUS
TUMOR OF THE HUMERUS.

FIG. 1.—Section of the head and of part of the shaft of a tibia, and of a tumor which has grown around it. The tumor consists of bone, cancellous in some situations, and ivory-like in others, also of soft substance, fibrous in some parts, and encephaloid in others. Deposits of ivory-like bone and of encephaloid substance have taken place into the medullary texture of the tibia.

FIG. 2.—Section of the lower part of the femur, from the same limb as the disease represented in Fig. 1.—In its medullary and cancellous texture there are deposits of fibrous and encephaloid substance, and of ivory-like bone.

FIG. 3.—Section of the upper part of the femur represented in Fig. 2. There are numerous deposits into its medullary texture, fibrous, encephaloid, and osseous. The walls of the bone are unusually dense. There are also deposits in the periosteum similar to those in the bone.

a, a—Fibrous and encephaloid deposits in the periosteum.

b—Skin covering the amputated end of the femur.

These growths from the tibia and from the femur belong to the class of malignant osseous tumors of bone which Müller has designated Osteoid.

The foregoing specimens were obtained from a female thirty years of age, in whom, on account of the tumor growing from the tibia, the limb was amputated through the lower third of the thigh. Two months afterwards she died. Fibrous, encephaloid, and osseous deposits were found in the femoral, iliac, and cervical absorbent glands, and in the pleura, pericardium, and lungs.

FIG. 4.—Cartilaginous tumor, occupying the entire shoulder. Its surface was noduled, and its subcutaneous veins were large. When the tumor had acquired a large size, the skin covering it gave way, exposing a large cavity in its centre, formed by sloughing and suppuration in its substance. Exhausted by these processes the man died.

The tumor consisted of soft cartilaginous substance, divided by membranous septa into distinct portions. Great part of the humerus had disappeared; its remaining portion was sound. The clavicle and scapula also were sound. No disease was discovered in any other part of the body.

This is a well-marked example of enchondroma, originating in the humerus of a man fifty-five years of age. It had been four years in progress. When the tumor had acquired a large size, the disorganizing processes of sloughing and suppuration to which such tumors are liable, ensued in its centre.

PLATE XX.

RICKETS.

FIG. 1.—Section of the femur of a child, softened and curved from rickets. The periosteum is healthy. The surface of the bone beneath it is rough and porous. The interior of the bone presents no division into solid walls and cancellous texture ; it consists throughout of a mixture of cartilaginous and gelatinous substances enclosed in cells.

FIG. 2.—Section of a femur, curved from rickets, which has become hard in its texture. The walls of the bone in the middle, and along the interior curve of the shaft, have acquired a much greater thickness than elsewhere.

FIG. 3.—Section of a tibia, bent from rickets, which has become very hard in its texture. At the part where the bone is bent, it is solid, without medullary tube or cells.

The femur represented in Fig. 1 shows the condition of the bones in rickets, in the second stage of the disease, when they present no division into solid walls and interior cancellous texture, but consist throughout of a mixture of gelatinous and cartilaginous substance, rendering them flexible and elastic.

In Figures 2 and 3 are shown the reparation of rickety bones, when they retain their bent figure, but have acquired hardness of texture, which often much exceeds that of healthy bone. The peculiar circumstances here to be observed are the excess of thickness in the walls of the curved bone on the side of its concavity, the solidity of the bone at the part where it is bent into an angle, and the generally oblique direction of the fibres extending across the interior of the curved bone. These are the sources of strength to the bone, compensating for its curved or angular figure.

Fig. 2.



Fig. 3.



Fig. 1.



Fig. 1

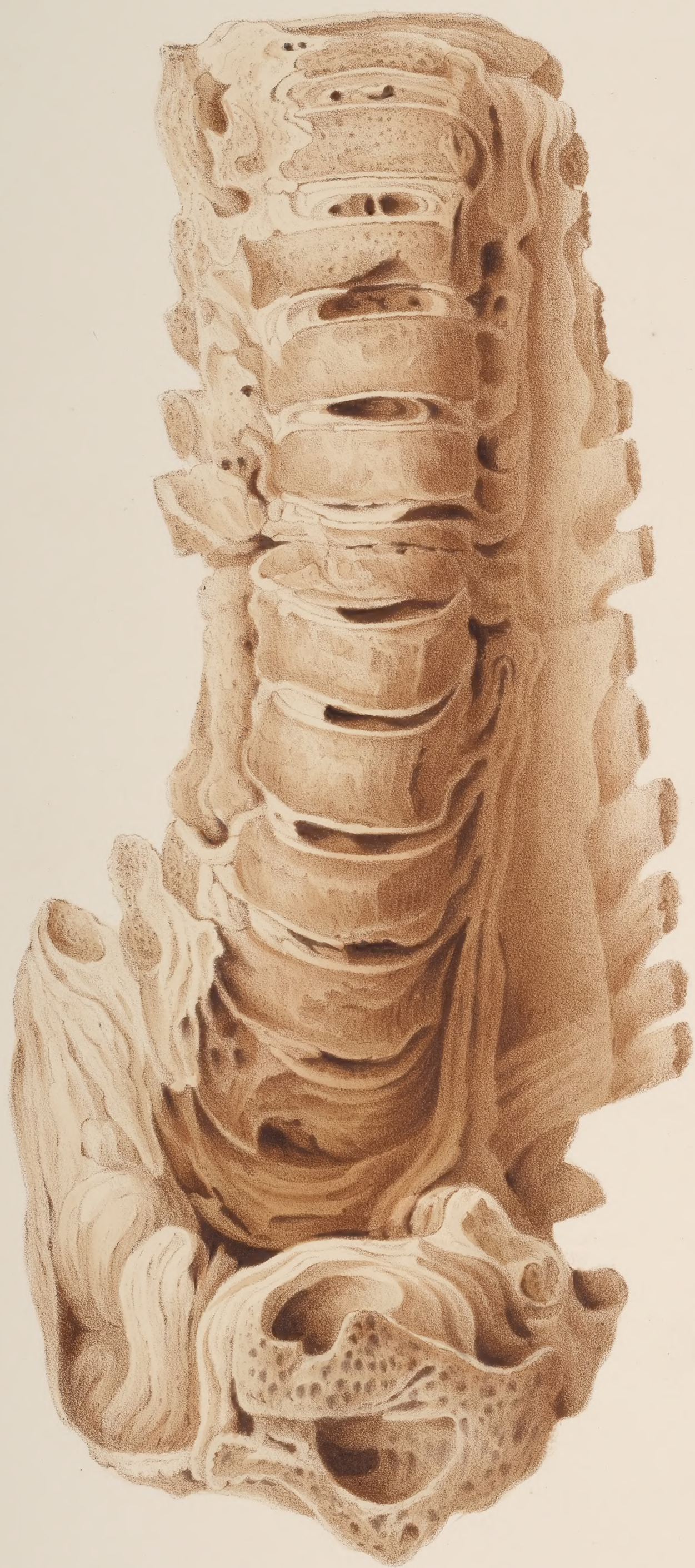


Fig. 2



Fig. 3

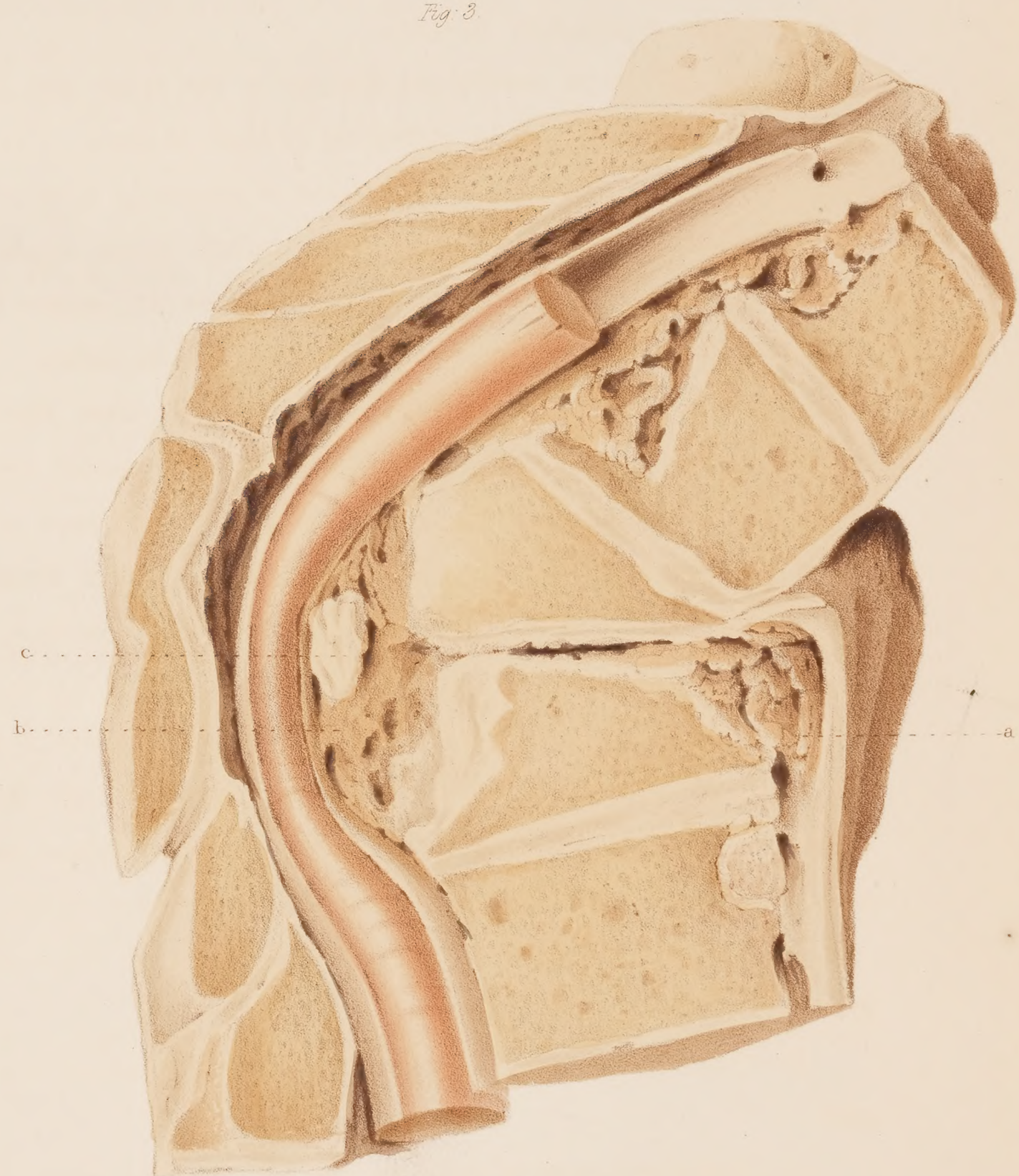


PLATE XXI.

DISEASES OF THE SPINE *.

FIG. 1.—Dorsal and lumbar portions of the spine of a young person, in which, from disease, the whole series of the intervertebral fibro-cartilages are destroyed. The upper and lower surfaces of the bodies of the vertebræ are ulcerated, but the bones are not softened, or otherwise altered in structure.

The remarkable feature of this case is the occurrence of destructive disease in the whole series of the intervertebral fibro-cartilages, followed by ulceration of the adjacent surfaces of the bodies of the vertebræ. Psoas abscess existed on one side of the abdomen; but, notwithstanding the great extent of disease in the spine, there was no affection of the spinal cord, and, consequently, no impairment of motion or sensation in the limbs.

FIG. 2.—Section of a portion of the spine of a young person, in which the destruction of the bodies of eight of the dorsal vertebræ by scrofulous disease has been followed by firm osseous union of the vertebral bodies bounding the vacant space, and by angular projection of the spinous processes. The spinal canal has been laid open, to show that, notwithstanding its altered direction, it is not narrowed at the seat of the disease. The spinal cord has become adapted to the altered direction of the canal, and it has not suffered compression.

In the early stages of this disease there was impairment of motion and sensation in the limbs. But in the later stage, when the disease had subsided, and whilst the reparative processes were in progress, sensation and motion in the limbs became completely restored.

These effects of scrofulous disease in the spine are distinct from the effects of ulceration of the bodies of the vertebræ unaccompanied by softening of their texture. In such cases the bones are simply ulcerated, or are previously hardened in texture, and the ulceration is generally confined to the front parts of the vertebral bodies. Consequently as the healthy vertebræ bounding the vacant space approximate, the posterior parts of the ulcerated bodies become forced backwards into the spinal canal so as to narrow the canal and compress the cord. The paraplegia which ensues must be permanent, from the nature of its cause. But when, from scrofulous disease, extensive and complete destruction of the vertebral bodies has ensued, then the vertebræ bounding the vacant space approximate without narrowing the spinal canal, and accordingly the spinal cord changes its direction in adaptation to the canal, but it suffers no compression. The affection of the spinal cord and of its nerves, arising from scrofulous disease of the spine, being usually but the effect of irritation imparted from the diseased bones to the cord, the affection subsides upon the cessation of the disease which has given rise to it.

FIG. 3.—Section of a portion of the spine, from a boy who was in St. Bartholomew's Hospital, under the care of Mr. Pott. Tuberculous matter is diffused through the cancellous texture of the bodies of the dorsal vertebræ. Three of these bodies are wholly destroyed, and others are in progress of destruction, both on their anterior and posterior surfaces. Tuberculous matter is deposited around the diseased bones.

a—Tuberculous matter deposited in front of the vertebræ, elevating the pleura costalis into a tumor projecting into the chest.

b—Tuberculous matter deposited into the spinal canal in such considerable quantity that it compresses the cord.

c—Detached piece of bone in the centre of the tuberculous matter.

In the early stage of this disease there was impairment of nervous power in the limbs, to the degree that the boy was unable to walk. But this power was regained by means of issues applied to the spine, under the direction of Mr. Pott. Some time afterwards the boy died from tuberculous disease in his lungs.

The foregoing case is remarkable, for it was one of the earliest instances of disease in the spine treated by issues, and the good which they had done was so distinctly marked, that Mr. Pott retained the boy in the Hospital, as an example of the efficacy of the new plan of treatment. Here his health failed, and he became again confined, on account of the disease in his lungs; and it must have been during this period that the tuberculous matter was deposited into the spinal canal so abundantly as to compress the cord.

* Treatise, Part IV. Chap. ii.

PLATE XXII.

REPARATIVE PROCESSES CONSEQUENT ON COMMUNUTED FRACTURE OF THE CRANIUM, AND ON COMPOUND FRACTURE OF THE TIBIA—NECROSIS OF THE OUTER LAMELLÆ OF A BONE.

FIG. 1.—Portion of a cranium, in which, two years before death, comminuted fracture occurred in the parietal and occipital bones.

a, b, c, d, e, f—Six pieces of bone, which were insulated by the fracture. Two of these have united to each other and to the adjacent part of the cranium by osseous substance, and the other two by fibro-cellular tissue.

The vacant space in the cranium was occasioned by the removal of several fragments of bone immediately after the occurrence of the injury.

The foregoing specimen practically enforces the caution to be used in disturbing insulated fragments of the cranium, for it shows in them ample power of re-union. It furnishes, besides, a good illustration of the mode of union. Four of the insulated fragments are united to each other and to the adjacent margins of the cranium by osseous substance. The ossific action effecting this union takes place wholly from the edges of the bone, and more from the inner than from the outer table, but without any direct aid from either the pericranium or the dura mater. Accordingly, after fracture of the cranium followed by the loss of bone, or after the use of the trephine, any diminution of the vacant space that may ensue, is effected by osseous fibres shooting out from the margins of the bones, and chiefly from their inner table. It might be expected that the inner table would take the larger share of the reparative process, since it receives a larger supply of blood from the vessels of the dura mater than the outer table receives from the vessels of the pericranium.

FIG. 2.—Part of a tibia, in which a compound fracture occurred some time before death. The two portions of the bone, in apposition by their lateral surfaces, are in progress of union. The fractured end of one portion has perished, and is in progress of exfoliation.

The dead bone is distinguishable by its yellow colour.

a—Osseous substance deposited upon the tibia along the border of the groove separating the dead from the living bone.

b—The groove between the living and dead bone. The surface of this groove is very vascular, as might be expected from the mode of its formation, which is, first, by increased vascularity of the living bone adjacent to the dead bone; next, by the softening of the living bone; and then, by the absorption of it in a manner to form the groove, which gradually deepens until the separation of the dead bone is completed.

FIG. 3.—Portion of a tibia, in which there is necrosis of the outer lamellæ, exhibiting the process of separation of the dead bone.

a—The dead bone of a yellow colour.

b—Layer of soft granulations produced from the living bone, and filling the channel between it and the dead bone.

c—Granulations from the surrounding parts, extending over the dead bone.

Fig. 1.



Fig. 2.

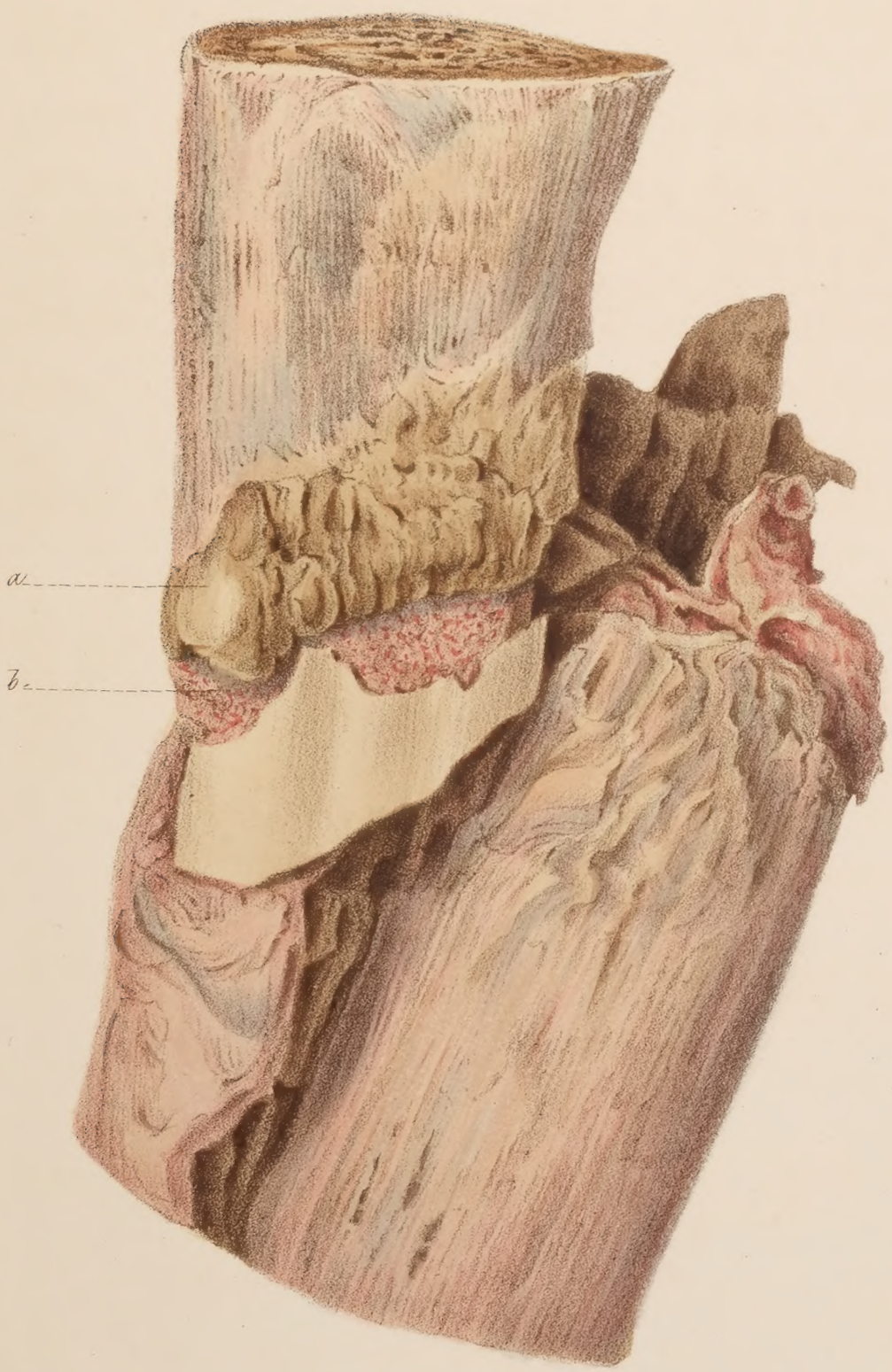


Fig. 3.

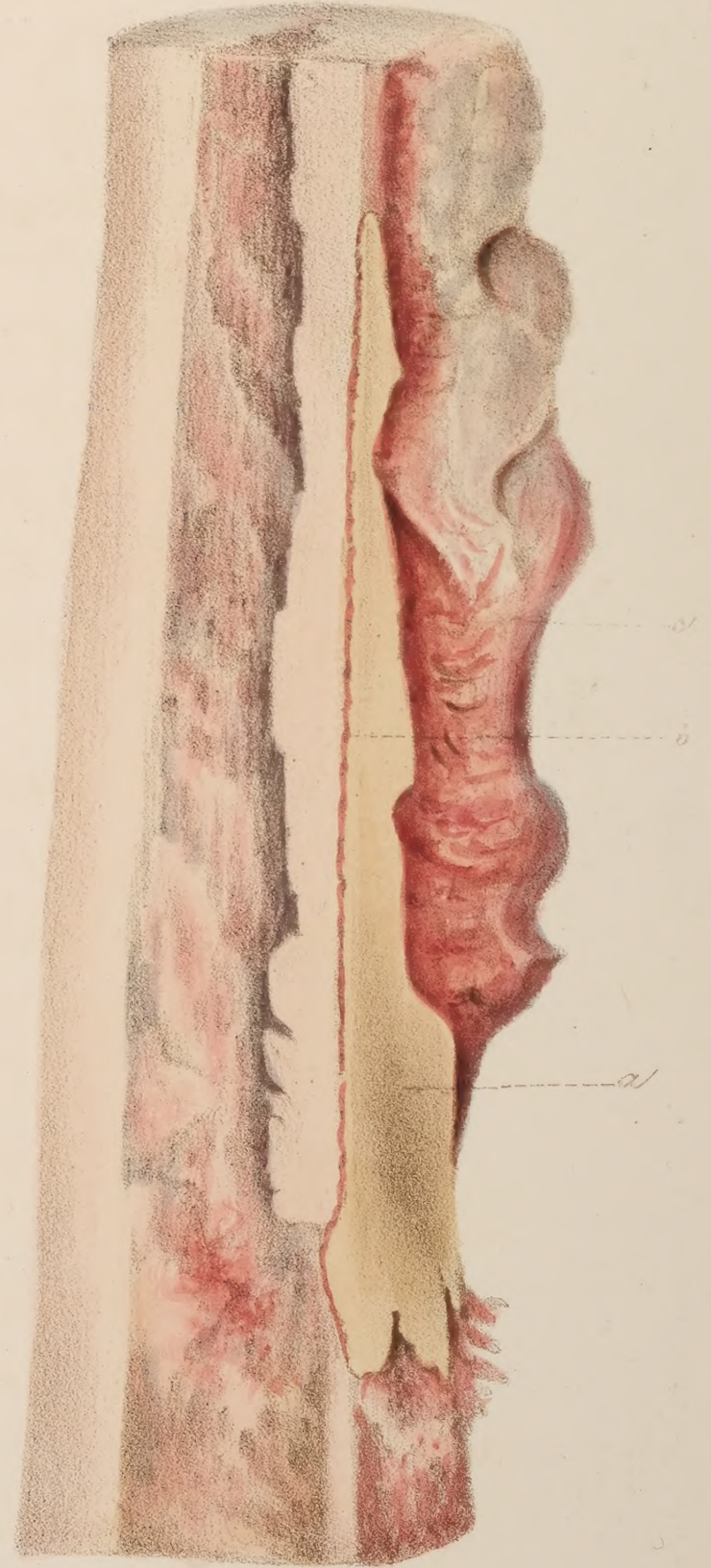


Fig. 1.



Fig. 2.



Fig. 3.

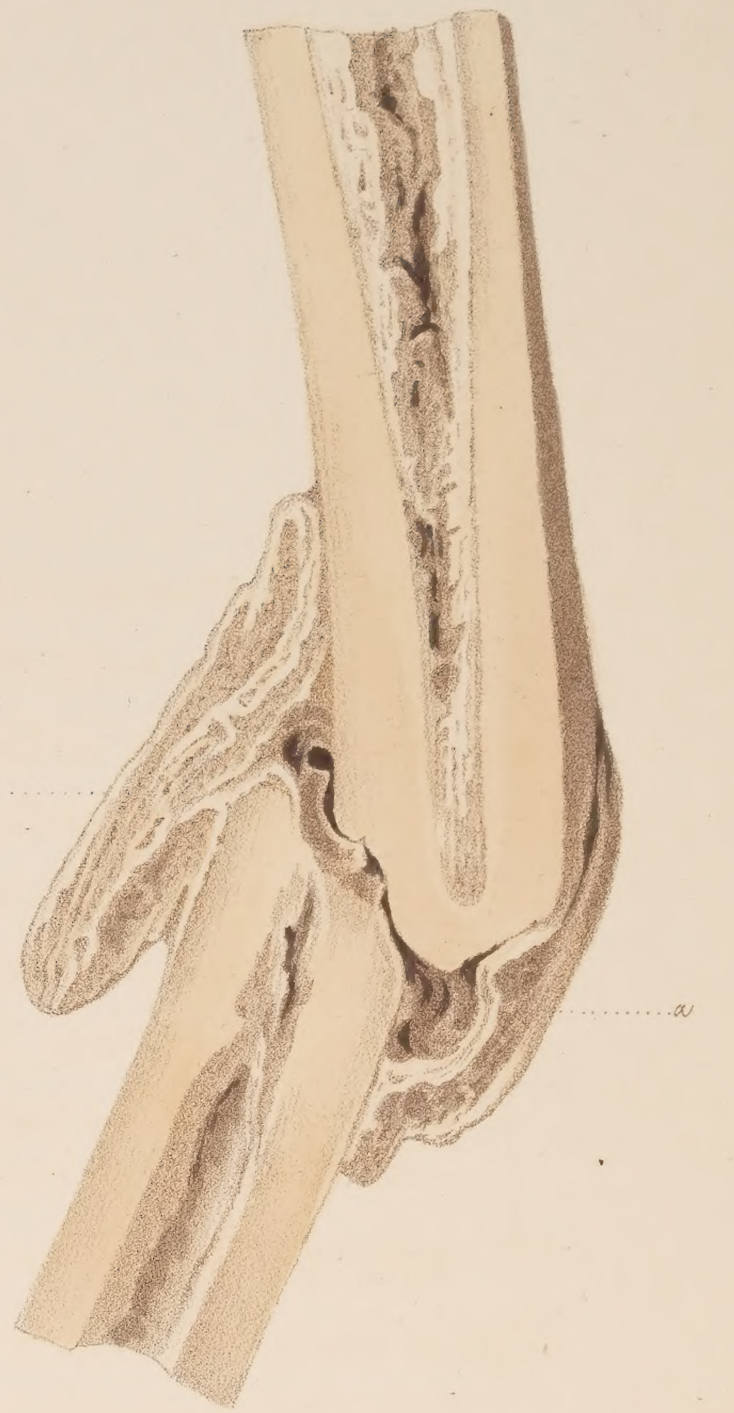


Fig. 5.



Fig. 4.



Fig. 6.

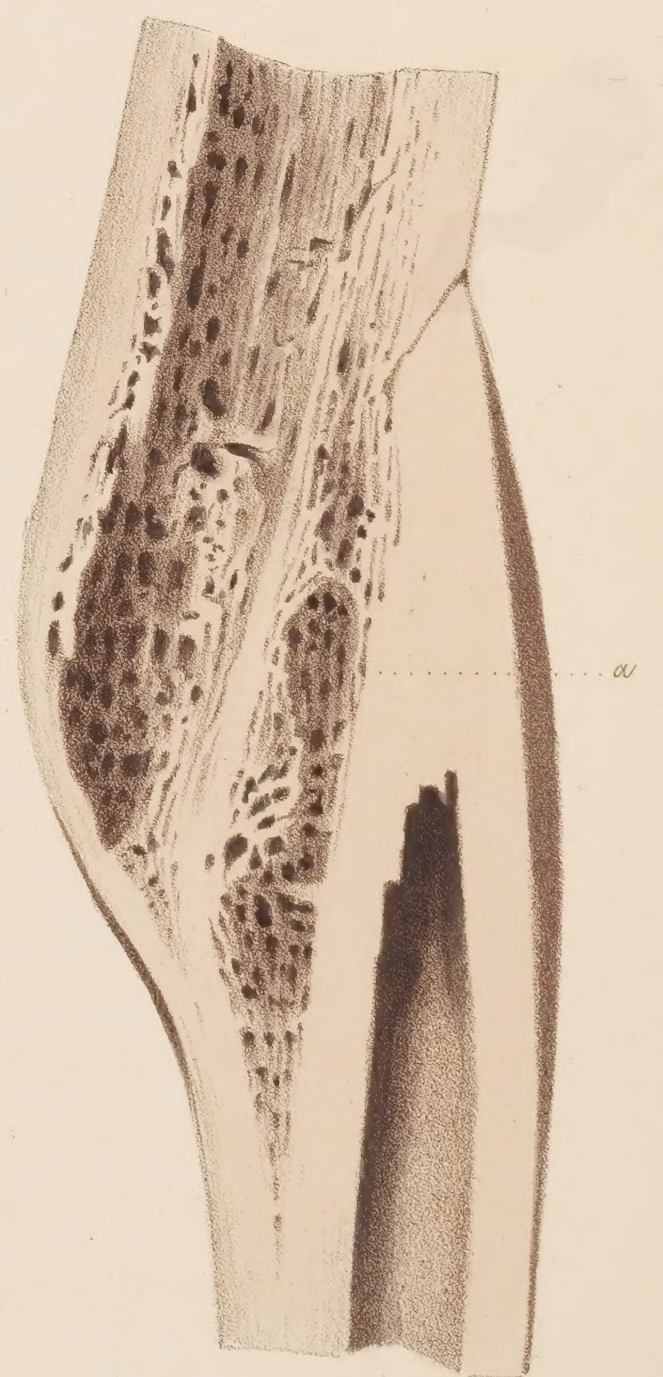


PLATE XXIII.

REPARATION OF FRACTURES.

FIG. 1.—Portion of a radius, in which there is an ununited fracture.

From a remarkably strong and healthy man, thirty-five years of age, who suffered a simple fracture of the radius and ulna. The ends of the bones had not been maintained in apposition and at rest, and, apparently from this cause, the fractures had not united. Nine months after the occurrence of the fractures, the ends of the ulna were exposed, and freely scraped, but nothing was done to the radius. Erysipelas ensued, and the man died. The ends of the radius were found to be connected only by cellular tissue. Not the slightest osseous deposit had occurred either between or around them.

a—Cellular tissue between the fractured ends of the radius.

FIG. 2.—Portion of a humerus, in which an ununited fracture was followed by the formation of a membranous capsule around the ends of the bone.

a, a—Divided edges of the membranous capsule, which has been opened to show the ends of the bone projecting into it. The internal surface of the capsule is polished, and its texture closely resembles that of synovial membrane.

b—The upper end of the bone very smooth, and covered by cartilaginous substance.

From a female forty years of age.

The two foregoing specimens of ununited fracture are examples of the least frequent condition of such bones at a distant period from the occurrence of the injury. More frequently the opposite surfaces of the bones are connected by an intermediate fibro-cellular tissue; and the failure of osseous union is then but an arrest of the reparative process, which has stopped short of the stage of its completion, when the fibro-cellular tissue should become converted into bone.

FIG. 3.—Portion of a humerus at the end of the sixth week from the occurrence of a simple fracture in it. There is no medium of connexion between the fractured surfaces of the bone, but its two portions are firmly held together by a broad ring of osseous substance, extending completely around the bone, and consolidated to its outer surface above and below the fracture.

From a very muscular and healthy African fifty-five years of age. Violent and uncontrollable spasms of the muscles of the injured arm immediately followed the fracture, and continued for several days. At the end of the sixth week the man was attacked by fatal inflammation of the epiglottis.

a, a—Divided surfaces of the osseous ring, which has a cancellous texture.

FIG. 4.—Section of a humerus which presents an example of the perfect union of a fracture. The ends of the bone, undisturbed, are in exact apposition. The only vestige of the fracture on the outside of the bone is a slight unevenness of its surface. The medullary and cancellous textures are completely reproduced at the seat of the fracture.

a—Seat of the fracture.

FIG. 5.—Portion of a femur, at the end of the seventh week from the occurrence of a simple fracture in it, which extended vertically through the shaft of the bone to the extent of five inches. The two portions, into which the bone was split, separated from each other to the distance of an inch and a half. This space is almost completely filled by osseous fibres extending horizontally between the fractured surfaces.

From a man sixty years of age. The fracture was the consequence of a fall upon the hip.

FIG. 6.—Section of a tibia, showing the union of a fracture where the periosteal surfaces of the two portions of bone had been in apposition. Between the two portions of bone and uniting them, there is a mass of newly developed cancellous texture, in no respect differing from the cancellous texture of original bone. At each of the fractured ends of the bone, the medullary tube is closed by compact osseous tissue.

a—Newly developed cancellous texture filling the space between the two portions of bone and uniting them.

PLATE XXIV.

REPARATION OF FRACTURES IN MAN, AND IN ANIMALS.

FIG. 1.—Tibia of a dog, exhibiting the process of union of a simple fracture. Examined on the tenth day.

a, a—Periosteum separated from the bone above and below the fracture. The periosteum was lacerated in the line of the fracture, but the laceration has in part healed; vessels were seen passing over it. Fibro-cartilage of a bluish colour, closely adherent to the periosteum and bone, is deposited between them to some distance beyond the fracture. Ossification has commenced in the fibro-cartilage close to the bone. The new osseous substance is dark-coloured from its vascularity.

FIG. 2.—Other half of the bone represented in Fig. 1. The periosteum is here separated from the fibro-cartilage, and from the bone beyond it.

FIG. 3.—Tibia of a dog, exhibiting the process of union of a simple fracture. Examined on the eighteenth day.

The fibro-cartilage deposited between the periosteum and bone is almost completely absorbed: its place is occupied by osseous substance, extending in the form of a ring (provisional callus) some way beyond the fracture.

a, a—Periosteum covering the osseous ring.

FIG. 4.—Portion of a tibia which suffered a compound fracture. The ends of the bone, although distant from each other to the extent of an inch and a half, have become united by a thick bridge of osseous substance extending horizontally between them.

a—Fractured end of the bone which has perished, and is in progress of separation.

b—Groove of separation between the living and dead bone.

c—Thin fragment of dead bone in progress of separation.

d—Thick bridge of osseous substance, extending horizontally between the upper and lower portions of the bone, and firmly uniting them.

FIG. 5.—Part of a femur, exhibiting the union of a fracture, where the periosteal surfaces of the two portions of the bone had been in apposition, to the extent of five inches. These surfaces are united by a broad and solid mass of osseous substance deposited between them.

Fig. 1.

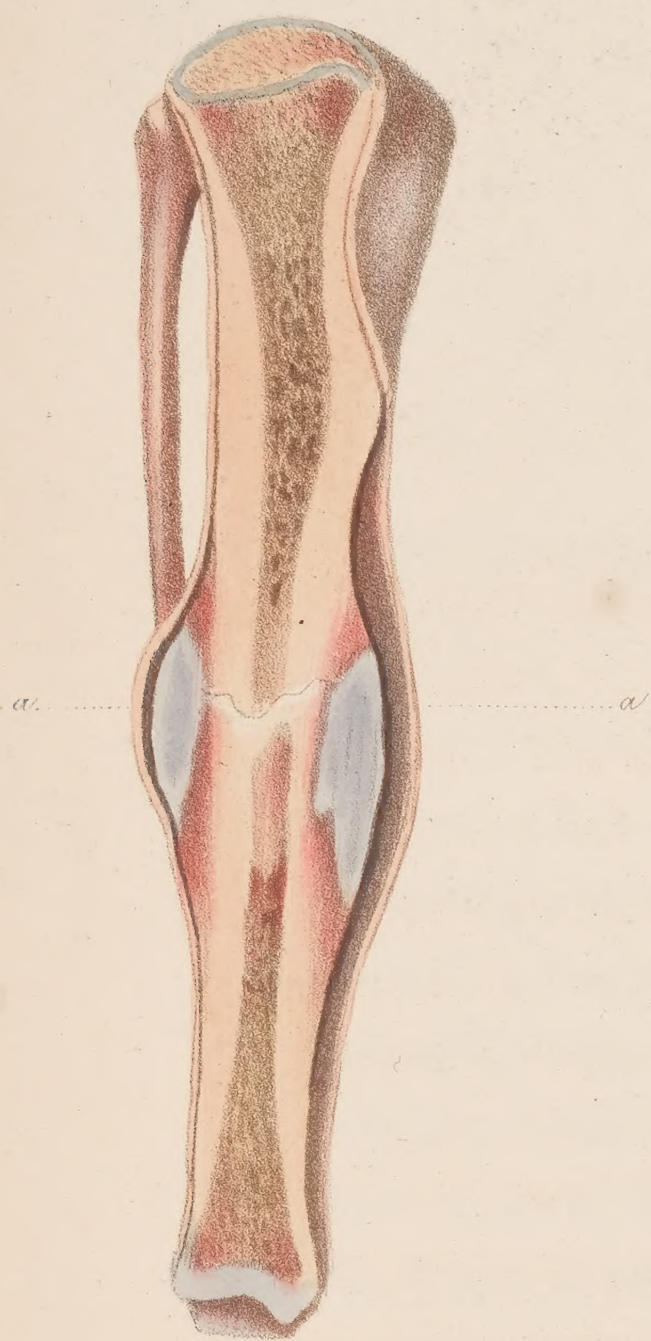


Fig. 2.



Fig. 5.



Plâte XXIV.

Fig. 4.



Fig. 3.



OBSERVATIONS ON THE REPARATION OF FRACTURED BONES IN MAN, AND IN ANIMALS.

It is not difficult to obtain the facts demonstrative of the mode of reparation of fractured bones ; the difficulty lies in connecting with the facts their rightful explanations and deductions. Experiment, for example, shows that in the long bones of animals, the process of union uniformly begins in the production of a mass of cartilage (provisional callus *) around the bones preparatory to the consolidation of their fractured surfaces. But, in man, such a process is observed only in a single bone, the rib. Here a mass of cartilage is formed around the ends of the fractured bone, maintaining them in contact whilst the consolidation of the fractured surfaces is in progress. And it may be, as stated by Mr. Paget, in his lectures recently delivered at the College of Surgeons, that in animals, since their bones are not at rest, this mode of reparation is needed for the maintenance of the fractured surfaces in apposition ; and that, in man, the ribs, from their office, being in constant motion, the same provision exists for the reparation of their fractures. This comparative view and conclusion, in respect to the provisions for the union of fractures in man and in animals, can be offered with much probability of correctness, from its accordance with the argument of design for a special good, with so much truth and eloquence set forth by Mr. Paget, in explanation of the various processes of repair after injury, in the several tissues of the animal body, and showing how exactly the material of repair, in respect of its quantity and quality, is every where furnished to meet the needs of situation and of all other circumstances besides. Thus we are enabled to interpret the many characters which repaired fractures exhibit, the wedges, buttresses, and bridges of osseous substance always found in the form and place necessary for the purpose of strength to the injured bone ; and in the same view we regard the results of the experiment of removing, in an animal, a portion of the radius with its periosteum, consisting in such an increase in the thickness of the ulna opposite to the vacant space in the radius, as fully to compensate for the diminished strength of the bone ; and thus, without regeneration of the bone that has been taken away, the limb of the animal loses none of its power of support †.

The principal facts concerning the reparation of fractured bones in man are comprised in the consideration of the nature and source of the medium of union, and of the characters and purpose of the adventitious osseous deposits around the fracture.

First, of the nature of the medium of union.

In the course of years, opportunities have occurred to me of examining fractured bones of every sort, and in every stage of progress, with the result of finding the substance developed between the surfaces in apposition, at first soft and cellular, then gradually hardening to the condition of a dense fibro-cellular tissue, and, in this stage, receiving the osseous particles which, by coalescing, convert this tissue into osseous substance, and consolidate it with the adjacent surfaces of the bone. And the characters of the intermediate substance have appeared to be the same, whether the fractured surfaces of the bone were in contact, or whether, by the overlapping of the ends of the bone, their

* Plate XXIV. Figs. 1, 2, 3.

† Museum of St. Bartholomew's Hospital. Third Series, Nos. 86, 87, 88.

periosteal surfaces were brought into apposition. To the question, whether the developement of cartilage in the fibro-cellular tissue precedes its ossification, I have to reply, that Mr. Paget, when engaged on this subject, found no cartilage corpuscles in five examples of this tissue which he examined, but, in the sixth and seventh, he did perceive them. Accordingly, it would appear that the uniting medium of fractured bones is formed indifferently by the ossification of fibrous tissue, or of cartilage, in accordance, it will be observed, with the twofold mode of ossification of foetal bones.

Next, of the source of the medium of union.

My impression respecting the source of the material which, by the changes it undergoes, becomes the medium of union between the portions of a fractured bone, is, that it is a production from the surfaces of the bone that happen to be in apposition; and I have observed, that although insulated points of ossification do arise in the intermediate tissue, the conversion of this tissue into solid osseous substance is effected chiefly by osseous fibres extending into it from the adjacent surfaces of the bone. These fibres are manifest in fractures examined at a stage short of perfect union, before the fibres have become consolidated into a solid mass of osseous substance. Thus the tissue of the bone itself produces the material which unites its opposite surfaces, whether these happen to be its fractured or periosteal surfaces, and even when the ends of the bone have become placed at a distance from each other, leaving thereby a considerable space between them to become filled with new osseous substance. Illustrations of these circumstances are presented in Plates XXIII. and XXIV. One of these displays a vertical fracture of the femur five inches in extent, followed by separation of the fractured surfaces to the distance of an inch and a half, yet the union of these surfaces is considerably advanced by the osseous fibres extending horizontally between them. Another displays a transverse fracture of the femur, followed by such an overlapping of its portions that their periosteal surfaces are in apposition to the extent of five inches, in which position they have become consolidated by a broad and solid mass of osseous substance formed between them; and there is a third illustration displaying the fractured ends of a tibia, separated from each other to the extent of an inch and a half, and yet firmly connected by a thick bridge of osseous substance extending horizontally between them.

There is no difficulty in determining the characters and purposes of the adventitious osseous deposits around fractured bones. The sources of these deposits are the tissue of the bone, the adjacent periosteum, and the surrounding cellular tissue. A proportion of these deposits constitute the wedges, buttresses, and bridges of osseous substance produced wherever adventitious support is wanted for the strength of the bone. Other of these deposits, arising from the periosteum, and from the cellular tissue adjacent to it, are proportionate to the amount of irritation which the fracture occasions in the surrounding parts. Accordingly, in the instance represented in Plate XXIII., where a simple fracture of the humerus was followed by uncontrollable spasms, continuing for several days, in the surrounding muscles, keeping the ends of the bone in constant motion, the irritation in consequence excited in the adjacent periosteum and cellular tissue gave rise to so large an osseous deposit in these structures that it formed a broad ring enclosing the ends of the bone and holding them together, without any union of the fractured surfaces. Such an extent of adventitious deposit as here occurred from the peculiar circumstances of the case, is a seeming parallel with the provisional callus in animals, but the osseous deposit was not, I am certain, preceded by a mass of cartilage, nor was it, like the provisional callus, formed between the periosteum and the bone. An osseous deposit of this character is dependent for its production on the amount of irritation excited in the soft parts around the fractured bone, and when the osseous plates and fibres deposited in the periosteum and cellular tissue coalesce into a solid mass, shaped as in the instance just described, into a broad ring extending around the bone, it becomes subservient to the good of keeping its fractured ends at rest.

A simple fracture of the tibia often unites without the slightest unevenness over the front surface of the bone; but if weight should be borne upon the limb before the union of the fracture is sufficiently firm to sustain it, then in the fifth or sixth week after the receipt of the injury, osseous deposits not unfrequently occur around the fracture with thickening of the periosteum and cellular tissue, giving rise to a swelling of the bone, seemingly analogous to the provisional callus in animals. And it is well to know that by such an osseous deposit around either a fractured femur or tibia, the ends of the bone can be held so firmly together, that it will sustain the weight of the body without the smallest amount of osseous union between its fractured surfaces. I examined a compound fracture in the tibia of a man sixty years of age, from which he had so well recovered as to be able to walk firmly. He died suddenly, at the end of the fourth month from the occurrence of the injury, when the fractured surfaces of the bone were found in apposition, but united only by a soft medium; the strength of the bone having been wholly derived from a ring of osseous substance formed around it at the seat of the fracture, and consolidated with the surface of the bone. In another instance of a simple fracture of the tibia, which I examined at the end of the fourth week from its occurrence, I found a thick osseous ring surrounding the bone at the seat of the fracture, but between the fractured surfaces there was not the slightest medium of connexion. Such occurrences are not confined to the bones of the lower extremity. In the museum of Dr. Hunter at Glasgow, I found an ulna, the fractured surfaces of which are in apposition, but unconnected, yet the ends of the bone are held firmly together by a thick osseous ring formed around them. On the other hand, in a fracture of the radius which Mr. M'Whinnie examined on the twelfth day after the receipt of the injury, he found a moderately firm union of the fractured surfaces, but without the slightest deposit of any kind around the bone.

The conclusions from the whole series of facts bearing on this subject may thus be stated,—that the undisturbed ends of a fractured bone in man unite by the medium deposited between its fractured surfaces; that the amount of adventitious osseous deposit accompanying the reparation of a fracture is proportionate to the degree of irritation which, from the unquietness of the ends of the bone, is excited in the surrounding parts; that the seat of this deposit is the periosteum and cellular tissue adjacent to it; but that the characters of this deposit are wholly distinct from those of the provisional callus in animals. Such will be the explanation of the seemingly irregular osseous deposits around fractured bones. The interpretation of other osseous productions, of well-defined shape and texture, found upon this or that side of a fractured bone, or filling up the hollows between its displaced portions, must be sought for by observing in what direction such additions of support and strength were required.

THE END.

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